Analysis of strategies in one British soccer team as a function of European and domestic competition.

Hollely, Chris

UNIVERSITY OF WALES SWANSEA

SPORTS SCIENCE

MPhil Sports Science
Dissertation

Analysis of Strategies in One British Soccer Team as a Function of European and Domestic Competition

Chris Hollely

Sports Science Department, University of Wales
Singleton Park, Swansea, SA2 8PP

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Abstract

Most investigations of strategies in soccer using notational analysis have focused upon competitions such as the World Cup or European Championships featuring International teams (e.g. Yamanaka, *et al.*, 1993; Luhtanen *et al.*, 2001). To enhance the practical application of previous findings a single team's strategies were assessed over a competitive season. Matches played in the domestic (Premier league and cup) and European (Champions League) competitions were compared for strategy differences. A computerised behavioural measurement package was used to record frequency and duration of possessions in different areas of the pitch. The nature of these possessions was deemed to be indicative of the team's strategy although it was acknowledged that the opposition's performance would influence possession also. Individual player possessions, passes and goal attempts were examined to aid understanding of the team's strategies. European matches were found to be characterised by more possessions in the pre-defensive areas (31.0%) at the expense of the pre-offensive areas (29.1%) when compared to domestic matches (29.6% and 30.0% respectively). Attacking play down the right hand side of the pitch occurred more frequently in domestic (5.8%) compared to European matches (4.4%). Some players were observed to have different ball possession and passing difficulty profiles between the two competitions (n=4) although other players (n=6) had similar profiles. These differences may have contributed to the superior goal to shot ratio found in the European matches (1:6.94 compared to 1:8.72). It is suggested that differences in tactical strategies were evident at both individual and team levels as a function of the nature of the competition. Whilst the influence of the opposition's play cannot be disregarded the variability of some player's roles suggests that strategy changes did exist and these were influenced by playing position and game circumstances. It is suggested that this team employs a defensive midfield player in European matches such that he could drop deep and act as an extra defender when the team are not in possession of the ball and act as an alternative passing option when in possession.

Acknowledgements

I would like to thank my Tutors, Nic James and Steve Mellalieu, for their invaluable assistance through out my study. Their patience and continued support were greatly appreciated.

I would like to thank my parents for their motivational skills and continual support, and an extra thank you to Peter Hollely for his grammatical assistance and proof reading prowess.

The help of two well respected individuals, one within the game of soccer and another in the notational analysis field, have been of assistance during this study. Firstly I would like to thank, Nick Hammond of Reading soccer club, who took the time to discuss certain aspects of the game with me, and secondly, Mike Hughes who provided me with a definition of notation analysis.

Finally, a big thank you must go to all my friends who kept encouraging me through out the year and ensured that I did not get too disheartened when things turned for the worst. I would especially like to thank Paul Jones and Nick Jones who were also undertaking post graduate projects for the team spirit generated between the three of us.

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1 Introduction

Without the provision of competent coaches, any athlete's potential will never be fulfilled (Gummerson, 1992). Consequently, in order to achieve and maintain high levels of performance an athlete cannot rely on their natural ability but must utilise high level coaching. Furthermore, for the coaching process to be effective the correct feedback must be provided to the performer. This is more complex in team games such as soccer, the sport considered in this thesis, as many individual contributions play a part in the overall performance. Therefore, to be able to give detailed feedback to soccer players not only are highly skilled coaches required, but ones with very good memories or recording devices that enable accurate recall of events. One objective method for providing this type of feedback, alleviating memory issues is via notational analysis which is defined as

> "*an objective way of recording performance so that key elements of that performance can be quantified in a valid and consistent manner*"
> (M.D. Hughes, April 2002, personal communication).

Notational analysis systems have developed from basic hand to modern computerised methods over the years with many different sports studied. The benefits of notational analysis systems include the provision of immediate feedback, the compilation of a database to allow comparison with previous performances, the indication of performance weaknesses, objective evaluation of performances and a means for collating video highlights i.e. selected aspects of play (Franks *et al.,* 1983; cited in Hughes and Franks, 1997).

Since the beginnings of early hand and computerised systems (e.g. Reilly and Thomas, 1976; Franks *et al.*, 1983; cited in Hughes and Franks, 1997) through to the development of contemporary software packages, soccer is a sport that has received considerable focus and attention from researchers in the notational analysis literature. Research has traditionally identified tactical information or described performance of

teams in international tournaments such as the Men's Soccer World Cups. For example, different tactical aspects of the 1990 World Cup were extensively analysed. Yamanaka *et al.* (1993) compared the playing styles of teams from different continents to see if there were any differences in the tactics they adopted. They suggested that British teams differed from the other continents in the way their attacks were built from defence, relying on long forward passes and dominance in the air. The European teams were observed to build up play by using short passes, runs and dribbles, thereby reducing the risk of losing possession. Partridge *et al.* (1993) compared the standard of play between the 1990 World Cup and the 1990 Intercollegiate Soccer Cup. They found that World Cup teams completed significantly more passes in a game and had fewer changes of possession than collegiate teams. Also in the attacking third of the pitch, World Cup teams lost more possession than collegiate sides. Bishovets *et al.* (1993) examined the predictability of attacking and defensive qualities of teams and found that defensive qualities did not seem to predict the effectiveness of a team. They suggested the most important factor for determining effectiveness was attacking moves and shots from within the penalty area. Similarly Luhtanen (2001) compared playing strategies in the 1996 and 2000 European Championships. Correlation analysis suggested success was predicted by defensive variables in 1996 and offensive variables in 2000. Summarising the research on soccer, Gréhaigne *et al.* (2001), suggested that much was descriptive and suggested progress towards prediction of performance was needed.

Considerable attention has been given to analysis of major international competitions, whereas few published studies exist for teams in their domestic league. These studies then tend to contain relatively small sample sizes which constrain the ability to infer team strategies (Church and Hughes, 1986; cited in Hughes and Franks, 1997). Consequently, there exists a need for a more comprehensive study of an individual team which could identify playing styles relative to different opponents. Whilst this information is specific to the analysed team and not, for example, other British teams,

at a later date findings could be tested for a sample of British teams with the purpose of inferring group norms.

This thesis therefore aims to address some of the weaknesses in the previous research of notational analysis in soccer. Unlike most other published work, an idiographic case study of a top British soccer team over a single season will attempt to identify strategic differences in performance when playing in European compared to domestic competitions. This will be achieved through analysis of variables thought to be performance indicators, namely, periods of possession in relation to areas of the pitch, player contributions in these areas, the level of difficulty of passes and an analysis of shots and goals. These will be examined with a view to considering whether they offer insights into the tactics adopted by the team. A problem with trying to elicit tactical information without recourse to the team itself (i.e. personal communication) is that team possessions are thought to be influenced by both the specific tactics employed by the team and the opportunities allowed by the opposition. Hence it is difficult to disentangle one influence from the other. This issue is pertinent to every match played as each different team played against will perform differently. However, it is thought that when a number of matches are studied each individual opposition style will merge into the style thought to exist in the respective competitions. Therefore it is expected that differences in the performance indicators will exist between the two competitions.

Many previous notational studies have reported the methodological procedures of data collection and the equipment used but few have documented the coding system and definitions for each performance indicator. This thesis will address this issue with a view to helping future researchers progress this critical methodological aspect of their work. It has also been suggested that previous research has lacked appropriate reliability studies (Hughes *et al.,* 2002). Reliability will thus be examined at the level of each performance indicator to give an accurate account of the coding structure and definitions.

Previous conclusions by many researchers suggest that different playing patterns exist between British and European countries (Yamanaka *et al.*, 1993; Luhtanen *et al.*, 2001). This thesis will investigate whether a British team alters their tactics when playing European compared to domestic matches. It is expected that possession of the ball will be kept for longer periods in European matches compared to domestic ones. Also in Europe more possession will take place in the defensive areas of the pitch because it is expected that less pressure will be placed on them by the opposition. This is a tactic previously associated with European teams and it is hypothesised that British teams playing in Europe would adopt these tactics to increase the likelihood of success. It is also noted that if the team analysed displays this tendency this does not necessarily mean that all British sides would do the same.

2 Review of Literature

2.1 Introduction

Notational analysis (the objective recording of action variables within different sports) has increased in prevalence in recent years. At the same time the associated technology to record and analyse the data of interest has also developed markedly. Notational analysis was first performed by hand using simple pen and paper techniques with more sophisticated computer packages typically used today. As a result the amount of information typically extracted from a sport is far greater than previously. In terms of soccer the prevalence and increase in sophistication of notational analysis has mirrored developments in other main stream sports. For example, Prozone is probably the most complex technical system presently used in soccer. This system links a number of cameras placed in the stadium through complex software to create a three dimensional reconstruction of all players and the ball. This is a commercial piece of software costing the clubs paying for this service approximately £3000 per game. Some English Premiership sides are known to have or are using this system. Unfortunately little is known about the system in the academic community at present due to commercial reasons. This chapter will review relevant literature from soccer analysis systems beginning with a brief overview of the role of feedback which is the main purpose of notational analysis. Notational analysis has evolved its own terminology which can be specific to an individual study. The terminology used has been interchangeable and can have different meanings. To alleviate this problem a glossary of terms (Appendix 1) has been provided to standardise the terms used in this thesis. The development of these notational analysis systems in soccer will be presented in tabular form to give a condensed perspective of this evolution. Finally, the findings of such systems in terms of their ability to give further insight on soccer strategies will be presented.

2.2 The role of feedback

Without feedback improvement in sports performance is impossible. It is typically through appropriate coaching and individual practice that teams and individuals improve their performances. Feedback can be viewed as any kind of sensory information about sports related movements and can be divided into two main categories, inherent and augmented (Schmidt, 1991). Inherent feedback is information gained as a natural consequence of making an action and cannot be controlled by any external factor such as a coach. For example, when kicking a football visual feedback includes the ball's trajectory and distance covered, proprioceptive feedback includes the sensation of contact between the foot and the ball and information regarding the muscular contractions invoked in kicking the ball. In many situations inherent feedback requires no evaluation but other aspects are not so easily recognisable and the learner may need to learn how to evaluate it. Augmented feedback on the other hand, consists of information about the performance that is in addition to the inherent feedback. This information may be fed back to the learner by some artificial means, such as a coach's voice or video tape replays and can be presented concurrent to, immediately after or at some time delay after the performance. For example, a coach may say that the weight transference during the kick was good or that more spin needed to have been applied to the ball. The common feature with all extrinsic feedback is that the feedback augments, or supplements, the information available through the senses (Schmidt, 1991).

One particular form of extrinsic feedback of significance to notational analysis is known as knowledge of results (KR). This is extrinsic information about the success of an action with respect to the environmental goal and is provided post-event. In soccer the outcome for the team is easy to assess i.e. goals scored for versus goals scored against. However the results of an individual performance are much harder to evaluate. This is typically where the coaching staff comes in to play. It is their ability to appraise an individual's contribution in a game that enables feedback (KR) to be

given to the players. This feedback is used to design training programmes to aid improvement for each player which in turn helps improve the overall team performance. This process is particularly difficult in a complex sport such as soccer and it has been argued that it is not possible for a coach to observe and retain detailed information on each individual performance simply through observing the game (Franks and Miller, 1986). Although it is possible to obtain an overview or opinion on each player's performance it has often been argued (e.g. Franks *et al.*, 1983; cited in Hughes and Franks, 1997) that notational analysis provides a comprehensive quantitative evaluation of individual contributions within the collective team performance.

Notational analysis can be defined as "an objective way of recording performance so that key elements of that performance can be quantified in a valid and consistent manner" (M.D. Hughes, April 2002, personal communication). It is the systematic and objective manner of data collection and analysis that characterises the advantages for notational analysis over simple coach observation and recall of events. Hughes (1996) suggested that there are four major purposes of notational analysis: analysis of movement patterns, tactical evaluation, technical evaluation and statistical compilation. This suggests that notation systems can be used to evaluate different aspects of the game of soccer depending on the focus of the investigation e.g. the overall tactics employed by the team, or individual contributions to this strategy. In this scenario the coaches and players can use the feedback gained from these analyses to provide a detailed assessment of their tactical play and individual performances and hence identify areas where improvement is required.

Notational analysis systems have long been used by researchers within sport as a means of assessing team and individual performances. Lyons (1996) reported that the earliest published academic accounts of notational analysis appeared in the *Research Quarterly* between 1931 and 1944. Lyons (1996) suggested that the notational work performed in *Research Quarterly* provided the foundation for future work in this area

and identified the importance of Lloyd Lowell Messersmith to this research. Messersmith published six articles over the thirteen year period, five of which were co-authored. The earliest published paper was a study of one basketball player in a university game (Messersmith and Corey, 1931; cited in Lyons, 1996). A sport specific notation system was designed and utilised to capture the data, the use of such a system was pioneering in notational analysis within sport. Since these early attempts at analysing sporting events the level of sophistication has increased in parallel with the advancement of computer and video technology. By developing from predominantly hand to computerised systems researchers have been able to gather and record more and more information as the computerised systems have increased in memory capabilities. This has enabled more complex analyses as illustrated by comparing two systems used to analyse the attacking patterns of play in soccer. The hand notation system used by Ali (1988) recorded 13 performance indicators from the game of soccer. These included dribbling, short pass, long pass, goal, off-side, shot on target, ball intercepted by goalkeeper, header on target, header off target, intercepted short pass, intercepted long pass, shot off target and the positions of restarts. The analyst attempted to ascertain whether there were specific and identifiable patterns of attack, and how successful each pattern was in influencing the result of the match. Only sequences in the attacking half of the pitch were considered and the patterns were recorded on a prepared pitch diagram in graphical form with the data later entered into a computer in terms of x, y co-ordinates which were then compared. The final action of each type of pattern was analysed to determine its influence on the game. The study was limited to only concentrating on the attacking half of the pitch which could have been due to the number of performance indicators studied. It was probably not possible to also notate these actions in the defensive half of the pitch using the hand notation system as the amount of information would have been too high to record and process. In soccer, attacking moves can begin in the defensive half, suggesting that important information may have been lost. When this study is compared to the computerised system Lewis and Hughes (1988; cited in Hughes and Franks, 1997) used, the differences in the level of analysis that the two types of

system can perform are evident. Lewis and Hughes (1988) analysed attacking patterns of play for successful and unsuccessful soccer sides. A total of 37 individual action variables (performance indicators) and 18 different pitch divisions were employed in the data collection process. When comparing this to Ali's analysis where 13 performance indicators were used and only half of the pitch studied this demonstrates the increased amount of depth that analysis can now be performed in using computerised systems. This is due to the computers ability to handle much more information than a human brain when hand notating a sport. The majority of notational systems that are now used in studies are computerised due to this fact. The next section will review all the relevant previous literature that has been published on notational analysis within soccer.

2.3 Notational analysis in soccer - research findings and methodological processes

The style of soccer that is currently seen in the Premiership would appear to be different to that of the 1980's and early 1990's (N. Hammond, January 2002, personal communication). A possible reason for this could be that the influx of continental talent into the game has altered the way teams now play. Indeed the influx of foreign players in the last decade alone has increased dramatically which is illustrated by the fact that there were 11 foreigners in starting line-ups for the first fixtures of the 1992-93 Premiership season, whereas for the first fixtures of the 2002-2003 season there were 101, not counting the Republic of Ireland (Atkinson, 2002). Although, to the knowledge of this author, no published notational analysis research has been conducted on soccer clubs in Division One and the Premiership during this time, several studies have looked at the playing styles of the British teams at the World Cups (Luhtanen, 1993; Yamanaka *et al.*, 1993; Yamanaka *et al.*, 1997; Luhtanen *et al.*, 2001). The findings of these studies may indeed reflect the style of soccer played in the top British league during this period since most of the players representing these countries played in their domestic leagues. For example, 21 of the 22 players in

the England squad that took part in the 1990 World Cup played in the British leagues. Four of these played for the Scottish side Rangers who were the best team in the Scottish league during that period and the other seventeen played in the top English league. The only player not to play in a British league was Chris Waddle who played in France for Marseille (Young, 2002). The studies of the World Cups suggested that British teams showed some noticeable differences in tactics and playing styles when compared to the European, South American and African nations. The British teams tended to rely on the long ball and their heading ability to initiate attacks whilst the other nations, especially the Europeans, preferred a more measured build up with more passes in the midfield area of the pitch.

Yamanaka *et al.* (1993) used computerised notational analysis techniques to study nations representing South America (Argentina, Uruguay and Brazil), Europe (Germany, Italy and Holland) and the British Isles (England, Eire and Scotland) in the 1990 World Cup in order to compare the patterns of play of the three groups. In addition to this research they also compared the playing patterns of the Cameroon side to those of the other three groups due to their unexpected success in the tournament. It was hypothesised that due to the different ways soccer had developed throughout the world, the range of climates in which it is played and the varying temperatures associated with individual nations that different playing patterns would be exhibited by the three different groups of teams. The researches used a specially designed computer keyboard which was a digitisation pad with 128 touch sensitive cells. With the use of an overlay placed on the keyboard the data entry was reported to be quick and simple. Twenty-four action variables (performance indicators) were analysed which were reported to have 'encompassed all possible activity within the game' although these were not listed or defined within the paper, nor the way in which they were used within a coding system to analyse a game. This set was reduced to ten indicators after analysis suggesting these were sufficient for statistical testing. In addition to the performance indicators the pitch was divided up into 24 areas to further supplement the analysis. This was reduced to six strip areas across the pitch

signified by 'A' at the defensive end through to 'F' at the attacking end once statistical analysis began. This could have been due to reliability issues with the data although this was not explicitly commented upon. Certainly with the pitch divided up into 24 areas each section is going to be quite small making it more difficult to accurately identify which area of the pitch the player is in each time compared to using just 6 areas. Reducing the areas of the pitch would have increased the reliability of the study. Twelve matches for each of the three groups were analysed along with four games for the Cameroon team. The twelve games for each group were merged and collated to produce mean patterns played by each group. The results suggested that the British teams performed significantly more headers in the whole of their opponents half of the pitch, 'D' to 'F', and the last third, 'A' of their own half compared to the European and South American teams. This led to the observation that there was a predominance of heading the ball in the British game and this was a significant factor in the definition of the patterns of play in the British game. The authors observed that sending long balls towards the opponent's goal was a simple tactic favoured by all British teams to a greater or lesser extent. This consequently results in a large number of headed balls. A second main finding was that British teams had significantly fewer passes in the midfield areas of the pitch, 'C' to 'E', whereas the European teams especially had many more passes in these areas. They also found that all three groups played down the centre of the field in the areas 'A' to 'D'. The difference between the British teams and the other two continents appeared in the final two areas of the pitch, the European and South American teams playing more centrally in area E and then towards the wings in area F. The British teams favoured the wings in both areas E and F. However playing the ball towards the wings in the final area of the pitch was a tactic used by all the groups of teams that were studied. This was a pattern that had previously been associated by Hughes *et al.* (1988) with unsuccessful sides while the successful teams approached the final sixth of the pitch by playing predominantly in the central areas. As two out of the three teams in each group went on to reach the latter stages of the competition it is argued that the Yamanaka *et al.* (1993) research opposes the findings in the Hughes *et al.*

(1988) study. When further analysis was performed on the distribution of play with Cameroon included, both the British and European teams exhibited a greater distribution of play out to the wings when attacking. Although the Cameroon side did not play the ball wide very often and therefore crossed the ball significantly fewer times than the other three groups of teams they still managed to have significantly more shots than the teams from the British Isles or South America which was concluded to be an important factor in their success in the tournament.

Yamanaka *et al.* (1993) also found that British teams had significantly more goal kicks than other teams and proposed that this highlighted one of the main tactical differences between the three groups with the British teams using the goal kick as a means of transporting the ball down field, into the opponents half. They reasoned that, although there is a risk of immediately losing possession, by tight marking and good tackling possession can be regained quickly with an overall gain in field position being made. This is supported by the fact that 60% of goals are scored as a result of possession regained in the attacking one third of the playing area (Hughes, 1973; cited in Hughes and Franks, 1997). It was also found that the British teams in the 1990 World Cup had significantly greater end of possessions in the areas C, D and F due to their tactics involving goal kicks and long forward passing. All these findings were concluded to illustrate that the British teams adopted differing playing tactics to the other groups in the way attacks were built from defence, via goal kicks and long forward passes, resulting in dominance in the air. European teams, however, were observed to build up play by using short passes, runs, and dribbles, thereby reducing the risk of losing possession.

The importance that Yamanaka *et al.* (1993) identified of moving the ball into wide areas of the pitch when attacking was supported by Jinshan *et al.* (1993) in their examination of the 1990 World Cup tournament. The authors attempted to clarify the characteristics of the goals scored in the 14th World Cup finals by analysing how a move resulting in a goal was initiated e.g. crosses, dribbling, set-plays and method of

shooting. The fifty-two games played in the tournament were studied with all 115 goals scored during the tournament analysed. The authors found that 32 goals (27.8%) were scored from an attack down the wing, most of which were completed by a cross, while only 4.3% of goals resulted from a cross from a deeper area of the pitch. The remaining goals were scored from central penetration (18.3%) or set-plays (32.2%). Jinshan *et al.* (1993) observed that each team paid special attention to the width of its attack to break the opposition's defensive line. A major limitation of this study however is the relatively small sample size of only 115 goals, which when broken down into the different attacking methods from which a goal was scored ranged from values of 37 down to 2. Consequently it has to be questioned whether any findings are reliable due to these small sample sizes. However, this research does highlight the importance of crosses in producing goals in this tournament with 37 goals being scored as a result of penetration down the wings (48.7% of the total number of goals scored from open play) and explains why Yamanaka *et al.* (1993) observed a tendency to play the ball wide in the attacking areas of the pitch. Partridge *et al.* (1993) also identified crosses as being an important way of creating goal-scoring chances. This study highlighted an important factor involved with crossing, namely when the ball is crossed into the space "behind" defenders but in front of the goalkeeper there is a much greater chance of the cross resulting in a goal. Partridge and Franks (1989a, 1989b) found that 37 out of the 38 goals scored from crosses in the 1986 World Cup were as a result of crosses made behind defenders. Partridge *et al.* (1993) also provided a similar finding with collegiate soccer. Of the seven collegiate games studied there were 31 strikes on goal and 8 goals as a result of crosses. These 8 goals accounted for over 50% (8 out of 15) of the total goals scored in the games that were analysed. Out of the 31 strikes resulting from crosses, only 10 were played "behind" defenders. Of these 10 strikes on goal, 4 were scored. In collegiate games, therefore, crosses played behind defenders for a strike on goal were more likely to produce goals (4 of 10) than crosses played in front of defenders (4 of 21). Although these statistics appear to suggest a trend towards a higher chance of a goal resulting from a cross being played behind defenders than in front of them the

fact that only 31 trials were studied casts considerable doubt over the validity of the findings. The issue of sample size in relation to how confident one can be of the findings has become more prevalent in current notational analysis literature with the recent discussion by Hughes *et al.* (2001) on establishing normative profiles.

A further analysis of the same 1990 World Cup tournament by Bishovets *et al.* (1993) examined the predictability of attacking and defensive qualities of the teams. Bishovets *et al.* (1993) aimed to analyse the structure of the moves of footballers and the effectiveness of collective technical and tactical moves (CTTM) during matches. They stated that realisation of these objectives would enable them to identify which various CTTM factors (performance indicators) positively affects the results of the game. All 52 matches in the tournament were analysed using a computerised system. The paper does not make it clear exactly what factors were analysed referring back to a previous paper by Gadjiev (1984) and only listing a few its self. During the 52 games a total of 32 collective technical and tactical moves were registered. The results were presented as percentages i.e. no frequencies, making it impossible to determine whether low numbers of observations were a problem for any of the factors analysed. The findings presented were similar to those of Luhtanen (1993), which was that defensive ability did not seem to determine the effectiveness of a team. Bishovets *et al.* (1993) found that the most important factors determining the effectiveness of the collective technical and tactical moves of a team were the attacking moves, number of critical movements and the shots from within the penalty area. It was also found that successful sides were more effective at making use of critical situations which they could create relatively frequently. Additionally it was found that successful teams had a high relationship between offensive and defensive moves. The successful teams had more effective collective moves, so they defended and attacked as a team with all the players involved. It was felt this was due to a more consistent and reliable understanding between players, whereas the unsuccessful teams were less consistent in team play, especially when shifting from defensive to offensive moves or vice versa. Therefore it would seem a team who have had a nucleus of players at the club

for a long period of time and should be very used to playing with each other would have a high understanding on the pitch allowing them to attack and defend as a unit rather than individuals i.e. the selection of a settled side wherever possible should lead to a more effective team performance due to the increased understanding between the players. Bishovets *et al.* (1993) concluded that the effectiveness of a team depends primarily on their attacking rather than their defensive ability; however, the ability of the team to turn defence into attack also appears to be of importance.

The ability to attack and defend as a unit depends not only on the team's organisation and training, but also their physical fitness. A trend, highlighted by Abt *et al.* (2002) and Jinshan *et al.* (1993), seems to be that the frequency of goals scored during a match is time dependent. A systematic and significant upward trend in the number of goals scored as time progressed was observed. Possible reasons for this were given as greater deterioration in physical condition among defenders and lapses in concentration. This would suggest fitness plays an important part in a team's success. This could also be expressed at an individual player level where the inability to contribute to the defensive shape of the team decreases the overall defensive effectiveness which in turn increases the likelihood of conceding a goal. However, a paper by Reilly (1997) which looked at fatigue within soccer suggested that this upward trend in goal scoring should not be attributed to a fall in work rate as it should affect both teams equally. Reilly (1997) proposed that the explanation was a complex phenomena including increased risk taking by the team that is behind, a change in tactics due to the proximity of the end of the game and lapses in concentration or mental fatigue. It would therefore seem an oversimplification to conclude that this upward trend in goal scoring towards the end of a match was only a consequence of the fitness levels of each team.

In an attempt to quantify changes in playing strategies Luhtanen *et al.* (2001) compared the Men's European Soccer Championships of 1996 and 2000. All of the matches in both tournaments were recorded and analysed by three trained observers

using a computerised match analysis system. The purpose of the study was to compare selected offensive and defensive variables (performance indicators) of field players and goalkeepers between Euro 1996 and 2000 and relate the results to the final team ranking in the respective tournaments. The quantitative, number of executions, and qualitative, percentage of successful executions, game performance variables (performance indicators) that the study analysed were: passes, receptions, runs with the ball, scoring trials, interceptions, tackles, goals and goalkeeper saves. The final ranking orders in the two tournaments were explained by calculating the rank correlation coefficients between team ranking in the tournaments and the ranking in the following performance indicators: ball possession in distance, passes, receiving, runs with the ball, shots, interceptions, tackles and duels. In doing this the authors could compare where each team's strengths and weakness were and what affect each of these performance indicators appeared to have on the teams level of success. The study used written definitions of each performance indicator to refer back to whilst notating a match, although these were not included in the paper. The inter- and intra-observer reliability for all the defined performance indicators was calculated using Pearson's correlation coefficients. Although this procedure is an important one to undertake to ensure the validity of the notation system the paper did not show the definitions they used or give the results of the reliability test.

The study showed that ball possession and the number of runs by players had decreased from the 1996 to the 2000 tournament, whereas tackles and interceptions increased (Table 2.1). It was thought that this was a result of a tactical shift by teams who perceived more importance in defence (2000 tournament) as opposed to attack (1996 tournament). However, correlation analysis indicated that conversely it was the defensive performance indicators that predicted the success of teams in the 1996 tournament and offensive ones (percentage of successful passes and the number of goal scoring trials) in the 2000 tournament. However, recent papers on appropriate statistical measures for notational analysis question the appropriateness of correlation for this type of analysis (Hughes *et al.*, 2002; Nevill *et al.*, 2002).

Table 2.1: Differences in Euro 1996 and Euro 2000 when comparing key areas of a soccer game (Luhtanen *et al.*, 2001)

	Euro 1996		Euro 2000	
	Average Per Team	Success Rate %	Average Per Team	Success Rate %
Ball Possession	6.4 km		5.7 km	
Passes	366	74	369	78
Runs	66	71	38	65
Shots and Headers	12	8	13	9
Interceptions	79	89	113	95
Tackles	71	51	134	47
Saves	4	69	4	69

The Luhtanen *et al.* (2001) study provided evidence that each country were of differing standards in each performance indicator and success in certain performance indicators did not necessarily reflect the level of success achieved by the team in the tournament. Holland, for example, were perennial under achievers constantly finishing lower in tournaments than their statistics suggest they should. In Euro 2000 Holland were the top team in ball possession (8.9 km of possession per game; calculated as the distance the ball travelled throughout a game when each team was in possession), second in the amount of passes and shots and they also came close to the top in the corresponding successful executions but they only finished third in the tournament. In Euro 1996 they had the most attacking activity and success rate performance indicators which would also suggest a higher finishing position than the eighth they achieved. Their strengths lie in their ability to maintain possession and their attacking play whereas teams such as Germany and Italy rely more on organised and dependable defences. Of course these findings may simply suggest that the data collected was not a good predictor of success. In contrast the results for Euro 2000 showed that the number of successful passes reflected exactly the final ranking that each team achieved for the tournament. France was the top team in this performance

indicator and won the tournament. They also finished top in the performance indicators of passes, receiving, runs with the ball and tackles. This is in stark contrast to the winners of Euro 1996, Germany, who were not the best in any performance indicator. The ranking system of performance indicators has provided interesting information on the team's strengths and weaknesses but it has not consistently predicted success. Indeed, Luhtanen *et al.* (2001) concluded that there was no obvious link between the success of a team and any of the performance indicators that were studied. However, it was apparent that where there had been an unexpected and successful team in one of the tournaments their play had been based on strong defence and high success rate in goal scoring trials (moves that culminate in a goal, although this is rather obvious).

The Luhtanen *et al.* (2001) study is one of a few that have compared strategies across tournaments. An earlier study by Partridge *et al.* (1993) investigated the technical performance of two teams of differing standard in an attempt to identify the influence of skill level upon strategy selection in soccer. All 52 games in the 1990 World Cup finals and 7 games from the World collegiate soccer championships were analysed using a computer assisted analysis system. The data was entered in "real time" and the analysis component of the programme allowed for results to be accessed immediately. The touchpad used for data entry was divided into two areas, the first consisting of a series of event keys and the second of a soccer field outline. The analyst used their right hand to depress the event keys as they occurred during a game and the left to mirror the movement of the ball on the soccer pitch. The study found that the senior World Cup teams successfully completed significantly more passes in a game and had fewer changes of possession than collegiate teams. It was also found that in the defensive third of the pitch the mean percentage of possession loss was similar. In the middle third collegiate teams lost more possession and in the attacking third the World Cup teams lost more. This would suggest that teams of a greater standard take more chances in the final third of the pitch when passing in an attempt to create more

goal scoring opportunities. However the low number of collegiate games reduces the validity of this suggestion.

The collegiate soccer figures suggest a potential trend that when possession was lost teams did not drop back deep into their own half to begin defending as effectively as the World Cup teams. Rather it appears they quickly tried to win the ball back which resulted in more changes in possession in the middle third of the pitch. Interestingly Partridge *et al.* (1993) suggested that the tactics of dropping deep when defending by the World Cup teams was not such an effective method of defending as the "pressurising" tactics used by the collegiate teams. The authors suggested that these tactics should be used to try to regain possession in the middle and attacking thirds of the pitch as they reduce the number of attacking third entries made by the opponents. This should result in a decrease in shooting and crossing opportunities for the opponents and consequently a reduction of their goal scoring chances. However the fact that the collegiate teams were playing against vastly inferior opposition compared to the World Cup teams appears to have been ignored when making this speculative statement.

Despite the detailed information gleaned, collectively, the preceding studies only provide a general overview of strategies employed by teams in specific finite international tournaments. Intuitively, one would expect more accurate reflections of soccer strategies and behaviours to be derived from an idiographic assessment of one team over a competitive season. This should be the case because one could expect the variability between teams in a World Cup type study would be absent in a within-team study. An example of one such attempt is the preliminary investigation by Church and Hughes (1986; cited in Hughes and Franks, 1997) into the presence of patterns of play in an English professional soccer team during the 1985-86 season. The system that was used enabled analysis of patterns of play on a team and individual level with respect to match outcome. It was one of few studies that looked at the individual's contribution to overall team tactics. Church and Hughes (1986)

found that a greater number of passes were attempted when losing than when winning, possession was lost more often when losing and a greater number of shots were taken when losing than when winning. However, despite the in-depth analysis and findings, the authors themselves acknowledged that the study was limited partially by the fact that only six matches were analysed.

Garganta *et al.* (1997) have recently provided some progress towards developing valid insights of team strategies by examining the patterns of play associated with success in five top European professional soccer teams. A key aspect of the study examined what the authors termed 'attacking reaction time', defined as the lapse in time between winning the ball and the shot on target. Over 50% of offensive actions that led to a goal were observed to occur from an attacking reaction time not exceeding 10 seconds for all five teams. Three of the five teams scored over 45% of their goals from an attacking reaction time between 0-5 seconds, with one of the teams scoring as many as 60% in this interval. For all five teams it was observed that between 47.7% and 85% of the moves that led to a goal involved only 1 to 3 players touching the ball and 61 to 93% of moves for each team were from periods of possession that contained no more than 3 passes. Therefore, if a team employed the defensive tactics suggested by Partridge *et al.* (1993) of pressurising the opposition higher in a more offensive area of the pitch they could be increasing their chances of scoring a goal. As goals tend to be scored so quickly after regaining possession of the ball, the closer to the oppositions' goal this can be achieved potentially the greater the chance of scoring as they have less distance and therefore less time to move the ball into the opposition's goal. If these tactics are adopted it means the attackers are just as important as the defenders when their team does not have the ball. The attackers would in effect become the first line of defence with the team defending from the front two players backwards as a unit.

2.4 Methodological issues in notational analysis

While the analysis of performance has benefited considerably from the significant advances that have occurred in the methods of notating team and individual behaviours this has not been without problems of measurement. Validity of measurement indicates the degree to which the test, or instrument, measures what it is supposed to measure. An integral part of validity is reliability which pertains to the consistency, or repeatability, of a measure (Thomas and Nelson, 2001). A key component in any research design that employs new equipment is the repeatability and accuracy of this apparatus (Hughes *et al.*, 2002). However, it is the exception (i.e. Hughes *et al.*, 1989; Potter, 1996; Wilson and Barnes, 1998) rather than the rule that most studies presenting new notation analysis systems produce evidence of systematic testing of the reliability of these new systems (Hughes *et al.*, 2002). In a review of 67 experimental notation analysis studies Hughes *et al.* (2002) found that 70 per cent of these did not present any mention of reliability studies. In addition, a further fifteen per cent used incomplete processes for confirming reliability. Hughes *et al.* (2002) emphasize the point that it is vital to demonstrate the reliability of a data gathering system clearly and in a way that is compatible with the intended analysis of the data.

Hughes (1996) suggested that all computerised notation systems should be tested for both intra and inter-observer reliability at the appropriate level of analysis. Inter-tester or inter-operator reliability examines the degree to which different testers can achieve the same measurement scores of the same subjects, whilst intra-tester or intra-operator reliability assesses the reliability of the tester to consistently measure the same variable (Thomas and Nelson, 2001). As few investigations have failed to provide any clear evidence of rigor in analysis procedures a need exists to examine the reliability of performance behaviour analysis measures.

Many previous studies that have been conducted on soccer divide the pitch up into smaller areas to allow analysis at a greater depth (Jinshan *et al.*, 1993; Luhtanen,

1993; Partridge *et al.*, 1993; Yamanaka *et al.,* 1993). However, all these studies divide the pitch up in different ways. The design of the grid system that a study is going to utilise is of importance as it can have a direct effect on the reliability of the study. If the areas are too large, the analysis may not be specific enough and as a result some potentially important information could be lost. If the areas are too small it could become difficult for the observer to accurately assess which area of the pitch the action is taking place in, therefore decreasing the reliability of the results. One study utilising a grid system was performed by Gréhaigne *et al.* (2001) who split the pitch into twelve box sections (see Figure 3.1). Length ways the pitch was split into quarters with the four observation areas being termed as: defensive; pre-defensive; pre-offensive and offensive. Across the width of the pitch running from one sideline to the other were three more areas. This created a central corridor with two bordering corridors. This made it possible to note play actions conducted down the key central areas of the pitch and the peripheral areas down the wings. The grids were not small enough to cause identification problems and allowed analysis in sufficient depth.

2.5 Summary

This review has examined the notational analysis literature for soccer, of which the main findings can be seen in Table 2.2, and has shown that differing tactics can be observed in previous studies between teams from different continents (Luhtanen., 1993; Yamanaka *et al.*, 1993; Luhtanen *et al.*, 2001). The British tactics have been observed to rely on long balls from the back and aerial dominance whereas European sides tend to build up play by using short passes, runs, and dribbles, thereby reducing the risk of losing possession (Yamanaka *et al.,* 1993). It would appear that the importance of offensive play has become a better predictor of a teams success than their defensive ability with Bishovets *et al.* (1993) identifying attacking moves, number of critical movements and the shots from within the penalty area as key performance indicators of success and Luhtanen *et al.* (2001) identifying the significant performance indicators as the percentage of successful passes and the

Table 2.2 – Summary of all the relevant previous papers in soccer notation

Authors (year)	Key objectives	Matches analysed	Key Findings
Luhtanen *et al.* (2001)	Compare selected offensive and defensive variables (performance indicators) of field players and goalkeepers between Euro 1996 and 2000 and relate the results to the final team ranking in the respective tournaments	All games from Euro 1996 and 2000.	Ball possession and the number of runs by players were observed to have decreased from the 1996 tournament to the 2000 tournament, whereas tackles and interceptions increased. Correlation analysis indicated that the defensive performance indicators predicted the success of teams in the 1996 tournament, whereas in the 2000 tournament the offensive side of the game was found to predict success, with the significant performance indicators identified as the percentage of successful passes and the number of goal scoring trials. Unexpected success in the two tournaments was based around a strong defence and a high success rate in goal scoring trails.
Partridge *et al.* (1993)	Investigated the technical performance of two teams of a differing standard in an attempt to identify the influence of skill level upon strategy selection in soccer.	All 52 games in the 1990 World Cup finals and 7 games from the 1990 World collegiate soccer championships were studied.	Senior World Cup teams successfully completed significantly more passes in a game and had fewer changes of possession than collegiate teams. In the attacking third of the pitch the World Cup teams lost more possession than the collegiate teams. Tactics of dropping deep when defending by the World Cup teams was not such an effective method of defending as the "pressurising" tactics used by the collegiate teams. When a ball is crossed "behind" defenders but in front of the goalkeeper into the space between them there is a much greater chance of the cross resulting in a goal.

Authors (year)	Key objectives	Matches analysed	Key Findings
Yamanaka *et al.* (1993)	Examine and compare the different playing patterns of teams from South America, Europe and the British Isles.	Games during the 1990 World Cup. 12 matches analysed for each of the three groups of nations (South America, Europe and British Isles).	British teams use long forward passes and goal kicks when building up their attack from defence and show dominance in the air over the other groups. European teams tend to build up play using short passes, runs and dribbles, reducing the risk of losing possession. Playing the ball towards the wings in the final area of the pitch was a tactic used by all the groups of teams that were studied. British teams had significantly fewer passes in the midfield areas of the pitch, 'C' to 'E', whereas the European teams especially had many more passes in these areas. Number of shots was also found to be a potentially good indicator for the success of a team.
Jinshan *et al.* (1993)	To clarify the characteristics of goals scored in the 1990 World Cup.	All 52 games during the 1990 World Cup. A total of 115 goals were analysed from the tournament.	27.8% of the goals were scored from an attack down the wing, most of which were completed by a cross. 4.3% of goals resulted from a cross from a deeper area of the pitch. 18.3% of goals were scored from central penetration and 32.2% from set-plays. 48.7% of the total number of goals scored from open play resulted from a cross.
Bishovets *et al.* (1993)	Analyse the structure of the moves of footballers and the effectiveness of CTTM during matches in order to establish performance indicators that positively affect the result of a game.	All 52 games during the 1990 World Cup. A total of 32 CTTM were registered over these games.	Most important factors determining the effectiveness of the CTTM of a team were the attacking moves, number of critical movements and the shots from within the penalty area. Successful sides were more effective at making use of critical situations which they could create frequently. Successful teams had a high relationship between offensive and defensive moves. Effectiveness of a team depends primarily on their attacking rather than their defensive ability

number of goal scoring trials. Of course since goals scored is the ultimate performance indicator in soccer it is not surprising that performance indicators directly related to scoring goals have been identified as key performance indicators of success. However no individual or group of performance indicators have consistently been shown to predict success.

Bishovets *et al.* (1993) also observed that successful teams were more effective at making use of critical situations which they could create frequently. Although the critical situations were not defined, it would appear that the suggestion is that a successful team takes more of its goal scoring chances than an unsuccessful one. This premise suggests that a team containing more skilful strikers will be more successful due to a higher proportion of strikes on goal. However, Yamanaka *et al.* (1993) suggested that simply the number of shots taken by a side was potentially a good indicator for the success of a team rather than the number of successful attempts (as originally suggested by Reep and Benjamin, 1968). Yamanaka *et al.* (1993) observed that playing the ball towards the wings in the final area of the pitch was a tactic used by all the groups of teams that were studied. From this wide area of the pitch, Partridge *et al.* (1993) and Jinshan *et al.* (1993) both highlighted the importance of crossing the ball in producing goal scoring opportunities with the former making a distinction between the delivery of a cross, with one played behind a defender more likely to produce a goal than one played in front. The importance of crossing may also explain the finding by Partridge *et al.* (1993) that a team of a better standard lost more possession in the attacking third of the pitch. It was suggested that better teams made more crosses and difficult passes in the final third of the pitch in an attempt to create a goal. Although the offensive performance indicators seem to be the better predictor of success, Bishovets *et al.* (1993) did observe that a successful team has a high relationship between offensive and defensive moves. This would suggest that a successful side transforms a defensive period of play quickly and effectively into an attacking period when possession of the ball is regained. Partridge *et al.* (1993) analysed the way in which two groups of teams of differing standards regained possession of the ball and observed that the "pressurising" tactics used by the collegiate teams were a more effective way of regaining possession than the tactics of dropping deep used by the World Cup teams. Although attacking performance indicators have been identified as good predictors of success it is not possible to

attack unless the team is in possession of the ball. This makes the way in which a team regains possession important and underlines how all these performance indicators are closely linked due to the free flowing nature of the game of soccer which makes it difficult to identify one performance indicator that has a dramatic effect on the level of success experienced by a team.

It has been the exception rather than the rule (Church and Hughes, 1986; cited in Hughes and Franks, 1997) that previous studies have looked at one team over a long period of time in an attempt to generate a performance profile of that team. A case study of this nature will have obvious limitations in the sense that the findings will only relate to that team and will not apply to a general population. However, studying one team over a season would be more likely to provide an accurate and reliable analysis of their performance from which conclusions can be drawn. Studies that analyse a group of teams produce results that can be attributed to a general population but with many more players and playing tactics involved in such an analysis the level of reliability generated in the results will decrease. A case study of this nature could be used to identify performance indicators that have an effect on a team's tactical performance and conversely the ones that have little effect. With the identification of these important performance indicators, if there is such a thing, studies could use them for future analysis in a more general analysis.

Many previous studies have looked at the level of success of differing teams in order to establish what makes a successful team. This thesis is a case study with only one team being analysed, therefore it is not possible to compare a successful team against a less successful one. However, previous studies have identified differing tactics between teams from different continents (Luhtanen, 1993; Yamanaka *et al.*, 1993; Luhtanen *et al.*, 2001). With the development of the European League over the past decade these tactics are regularly being contrasted. In an attempt to identify a tactical change by the studied team in domestic compared to European competitions, many performance indicators will be analysed in order to establish which appear to have an effect on team tactics. Additionally, the majority of previous studies in soccer have focused on either team or individual player analysis, rather than the two simultaneously (apart from Church and Hughes, 1986; cited in Hughes and Franks, 1997), this thesis will attempt to analyse the contribution that individuals make during

a game in relation to the overall tactics exhibited by the team. Finally, the lack of previous reliability work in papers (Hughes *et al.,* 2002) will be taken into account and the appropriate testing will be performed on the analysis system that this thesis utilises.

3 Methodology

3.1 Introduction and study design

A computerised video analysis system, the Noldus 'Observer Video Pro' behavioural measurement package (Noldus Information Technology, 1996), was used to analyse twenty-one matches played by a top European soccer team throughout the course of the 2001-2002 season. The number of games available for analysis was restricted by the amount of television coverage given to the team over the season. The games were recorded from terrestrial and satellite television. Matches from the National League and Cup competitions and the European Cup competition were analysed to examine the difference in playing styles for the domestic and European competitions.

3.2 Participants

In order to develop an idiographic assessment of soccer strategy a professional British soccer team were sampled during the 2001-02 season in domestic and European competition. The first team squad contained twenty-nine players ranging from twenty to thirty-nine years of age (mean = 27.17, standard deviation = 4.82) and twenty-five of these players participated in the twenty-one games that were analysed. Sample selection was made on the basis of the criteria that the team had played in both domestic and the European Champions league competitions over the past five seasons and were deemed relatively stable performers in both settings. During this period the team played 190 domestic games, winning 62% and losing 12.5% whilst 405 goals were scored and 183 conceded. In European competition of the 57 games played the team won 49% and lost 23%, scoring 97 goals and conceding 51. Of the twenty-one matches that were analysed the team played 12 domestic games, winning and losing 41.67% each, scoring 18 goals and conceding 22. In the 9 European games the team won 44.5% and lost 11%, scoring 18 goals and conceding 7. These results highlight a potential methodological limitation in the sense that the success

rate of the side has not been balanced for European and domestic soccer. The success rate of the side is a variable that may influence the performance indicators studied although it will be argued that this is not necessarily a good measure for the possession data analysed. Where possible matches were balanced as well as possible e.g. five of the nine European games (55.56%) and six of the twelve domestic games (50%) were played at home. Also all games took place in good playing conditions with no rain in any matches and no pitches of a substandard nature being played on. However, all European games were an evening kick off whereas the majority of domestic games were afternoon. Controlling for variables such as these was impossible but it is thought unlikely that these particular variables would have had a dramatic affect on performance. It is more likely that variables implicit within the game e.g. an injury to one player, also impossible to control for, would have a more dramatic affect on playing styles. It is therefore suggested that whilst confounding variables have to be considered during the analyses it is impossible to control for all eventualities and that a more pragmatic approach is too consider the effect of as many potential confounding variables as possible during the analyses. This is covered more fully in the results and discussion sections.

3.3 Instruments

In notational analysis it is important to decide what information is required from the system prior to its design (Hughes and Franks, 1997). One way of achieving this objective is to develop performance indicators which describe behaviours that are thought to be indicative of successful performance (e.g. a successful pass). The identification and definition of performance indicators enables a sporting performance to be assessed in relation to the level of success achieved in each indicator. This forms the basis of an objective form of assessing each soccer player's performance, and hence that of the team. Soccer, when compared to other invasion games such as rugby or hockey, is a free flowing game which is arguably less influenced by set pieces. For example, in rugby, scrums and line outs are a key component of the game with set

moves being produced as a result of these set pieces. In hockey, short corners are pivotal set pieces and are the primary method by which goals are scored. In soccer, however, the game has proportionately fewer set pieces and as a result appears more disorganized with longer periods where the ball is in play. This makes analysis of soccer far more complex. Whilst the correct identification and definition of performance behaviours before designing a coding system is crucial (Rico and Bangsbo, 1996) this alone is unlikely to unravel the complexities of soccer strategy.

The performance indicators utilised in this thesis were established in four stages. First, an initial design containing definitions of performance indicators was constructed by the researcher. Second, in order to ensure the definitions were sensible and did not include any unclear operational definitions, the system was piloted by the researcher. Unclear operational definitions refer to any anomalies which were found during the early stages of analysis and identifying these prevented future potential problems with the notation system. An unclear operational definition was corrected by either changing the wording for that operational definition or by adding a new code to account for a previously not considered aspect of play. After three matches had been analysed it was thought that all unclear operational definitions had been amended. The list of performance indicators were then passed on to an independent researcher (over thirty years of soccer knowledge) to assess and any subsequent corrections then made. The final step of the process required two experienced soccer coaches (over fifty years combined experience) to analyse the performance indicators to ensure that there were no further errors in the definitions. Subsequent analyses conducted during this research supported this process as no more unclear operational definitions were found. The main performance indicators and definitions used in this study can be seen in Section 3.4. In addition to analysis of these key indicators for individual player performance a further variable of interest was the area of the pitch each player occupied whilst performing the skills. A grid system of 12 areas (Figure 3.1 overleaf) was used based upon the work of Gréhaigne *et al.* (2001).

Figure 3.1 Structure of the grid used to identify strategic areas of the soccer field.

Several other studies have used similar grid formats although this one was chosen because it encapsulated both lateral and longitudinal elements of interest to this study. The main purpose of using the grid system was to "give some idea of the dynamics of the play" whilst also allowing the identification of "the main dimensions of the play, and the prevalent distribution of the players on the pitch" (Gréhaigne *et al.*, 2001, p. 55). This grid was the preferred format as the areas were small enough to provide a picture of the general playing patterns of a team, but not too small, which would make it difficult to identify which area of the pitch the player was in.

To aid the identification of the grid areas on the pitches, individual analysis of each pitch was carried out before coding began. This analysis identified any marking that could help the identification of each area e.g. advertising hoardings or the patterns cut into the grass. With the pitch divided into grid sections it allowed very accurate areas to be determined e.g. the left defensive area could have been three squares wide by five squares long. If the pitch was simply cut into strips then it was possible to identify between the defensive/pre-defensive areas and the offensive/pre-offensive areas accurately but it was not as easy to identify exactly where the right, middle and left areas of the pitch were. The edge of the penalty area and advertising hoardings were the only definite guidelines as regards the areas running across the pitch.

3.4 Coding structure and definitions used to record performance indicators

In order to code individual events within the game (for example, a pass) each event has up to four parameters (Table 3.1), the first being the player instigating the action, the second the area of the pitch where the event starts, the third the type of action carried out and finally the result of that action. The area in which the event takes place is coded in the system as keystroke 3 due to limitations (a lack of behavioural fields) within the Observer software used for the analysis. For the simplicity of this section it

will be shown as keystroke 2 as this makes more intuitive sense. This order has no effect on the information that is entered into the system, or the structure, shown.

Table 3.1: The performance indicators and their associated parameters

	Key Press			
Section	1	2	3	4
3.4.1.1	Player	Area of Pitch	**Beginning of Studied Teams Possession**	Method of Gaining Possession
3.4.1.2	Player	Area of Pitch	**Beginning of Oppositions Possession**	
3.4.1.3	Player	Area of Pitch	**Beginning of Neither Teams Possession**	Key Events in Play
3.4.2	Player	Area of Pitch	**Caught in Possession**	
3.4.3	Player	Area of Pitch	**Tackle**	Body Part and Outcome
3.4.4	Player	Area of Pitch	**Set Pieces (Free Kicks, Corners and Penalties)**	Outcome
3.4.5	Player	Area of Pitch	**Throw In**	Outcome
3.4.6	Player	Area of Pitch	**Goal Kick**	Outcome
3.4.7	Player	Area of Pitch	**Pass**	Difficulty, Contribution within the game and Outcome
3.4.8	Player	Area of Pitch	**Dribbling the Ball**	Finishing Area of Pitch
3.4.9	Player	Area of Pitch	**Attempts at Goal**	Body Part and Outcome
3.4.10	Player	Area of Pitch	**Clearance**	Body Part and Outcome
3.4.11	Player	Area of Pitch	**Saves**	Outcome
3.4.12	Player	Area of Pitch	**Substitutions**	Player

3.4.1 Possession

In order to calculate the time a team had control of the ball within a match, possession start and end points were recorded. Possession was deemed to start when a team gained control of the ball e.g. at kick off, when a tackle is made or a corner kick taken. This was recorded as either the studied team's (Section 3.4.1.1) or the opposition's (Section 3.4.1.2) possession. Possession was deemed to continue from the first touch of the ball (if deemed under control) until possession was lost, which was either when the other team gained possession e.g. through a tackle, or as soon as the play was stopped e.g. a foul was committed or the ball went out of play. During periods of stoppage e.g. ball out of play, neither team had possession and so a special code was recorded to signify this (Section 3.4.1.3). This state remained until play resumed and one of the two team's regained possession. This method of coding consequently results in three alternative types of possession: the analysed team, the opposition or no possession. It was thus unnecessary to record the end point of a possession as the beginning of the following period of possession was used to signify this.

3.4.1.1 Studied team's possession

This was deemed to begin when one of the players from the studied team 'gained control' of the ball. Gaining control is defined as the player (or one of his team-mates) having the option to do something voluntarily with the ball. If a player touches the ball as he slides in to attempt a tackle but does not succeed in dispossessing the ball carrier then possession is not coded as having changed. However, if as a consequence of the sliding tackle, the ball ricochets to a team-mate who controls the ball then possession is deemed to have changed. The coding structure therefore allows the researcher to analyse how, where and by whom possession was gained by the studied team, which may highlight defensive tactics which were adopted.

Table 3.2: Codes used when the studied team gain possession

Key stroke			
1	**2**	**3**	***4***
Player	Area of Pitch	**Studied Teams Possession (u)**	**Possession won through a tackle (t)**
			Possession won through an interception (i)
			Possession won through a header (h)
			Possession through a set piece (s)

3.4.1.2 Opposition's possession

This was defined as beginning when an opposition player gained control of the ball using the same criteria as the previous section (3.4.1.1).

Table 3.3: Codes used when the opposition gain possession

Key stroke			
1	**2**	**3**	***4***
Player	Area of Pitch	**Opposition's Possession (o)**	**No keystroke used**

The way the opposition gained control of the ball was not coded as this was not of interest to the present study.

3.4.1.3 No possession

When the ball was out of play neither team was credited with possession. Typically, this involved the periods preceding goal kicks, throw ins, free kicks, injuries and

cautions. Whilst it was important to record this change in possession (to keep an accurate record of each team's time of possession) the mode of change was not usually of significance e.g. if the ball has simply gone out of play for a throw in. However, when the opposition had an attempt at goal or indeed scored this was deemed significant and recorded (Table 3.4).

Table 3.4: Codes used when neither team had possession

Key stroke			
1	**2**	**3**	***4***
Player	Area of Pitch	**Neither Teams Possession (v)**	**Opposition Goal (s)**
			Opposition Miss Chance at Goal (w)
			Non Critical Passage of Play (n)

3.4.2 Caught in possession

When a player from the studied team gets tackled the event is coded as 'caught in possession'. If the player gets tackled and the ball goes to another player on the same team the period of possession does not end. However if the player gets caught in possession and the ball goes out of play, or to the opposition, the period of possession does end.

Table 3.5: The code used when a player from the studied team is caught in possession of the ball

Key stroke			
1	**2**	**3**	***4***
Player	Area of Pitch	**Caught in Possession**	**No keystroke used**

3.4.3 Tackle

Any challenge made by a player from the studied team in an attempt to dispossess the opposition of the ball.

Table 3.6: Codes used when a player from the studied team attempts a tackle

Key stroke			
1	**2**	**3**	***4***
Player	Area of Pitch	**Tackle (t)**	**Successful (s)** The ball carrier is deprived of the ball
			Unsuccessful (u) A player enters a tackle and does not dispossess the ball carrier.

It should be noted that a successful tackle does not necessarily end a period of possession. This is because a tackle may result in the ball falling to another opposition player. However, the tackle has been successful in terms of depriving the opposition of its original intention.

3.4.4 Set pieces

Set pieces are dead ball situations that originate from the ball going out of play or a foul e.g. free kicks, corners and penalties. Goal kicks and kick offs are coded separately. A free kick was defined as a set piece awarded for a foul on one of the studied teams players, the free kick could be direct or indirect.

Table 3.7: Codes used when a member of the studied team takes a set piece

Key stroke			
1	**2**	**3**	***4***
Player	Area of Pitch	**Free Kicks (f)**	**Leading to a goal (l)** Begins a period of possession which leads to a goal.
			Assist (a) Is the final pass before the goal is scored.
			Leading to a chance (c) Begins a period of possession which leads to a chance on goal.
			Goal (g)
			Going to a team mate (t) Set piece is taken and the ball goes to a team mate but nothing of consequence comes of the set piece.
		Corners (c)	**Loss of possession (p)** Ball goes to an opposition player or the free kick is kicked straight out of play.
		Penalties (s)	**Foul on one of the studied team's player (f)** Set piece is taken and a player from the studied team is fouled whilst the ball is in the air.
			Foul by a player on the studied team (u) Set piece is taken and a player from the studied team commits a foul whilst the ball is in the air.
			Short Corner (q)
			Attempt on target (s)
			Attempt off target (o)

3.4.5 Throw ins

A throw in was defined as the restart of play from the sidelines via the hands of an outfield player.

Table 3.8: Codes used when a member of the studied team takes a throw in

Key stroke			
1	**2**	**3**	***4***
Player	Area of Pitch	**Throw In (e)**	**Throw into the box (l)** Reaches one of the studied teams players who are in the opposition's penalty area.
			Throw in (t) Successful throw in that is not thrown long into the box.
			Unsuccessful throw in (u) Does not reach one of the studied teams players.

3.4.6 Goal kicks

A goal kick was defined as a kick taken from the ground used to restart play after the ball has gone out of play or a kick from the hands after the goalkeeper has picked the ball up. The main objective of the kick is to clear the ball down field, but it has been suggested that some British teams use it as an offensive tactic (Yamanaka *et al.*, 1993).

Table 3.9: Codes used when the studied team's goalkeeper clears the ball from the penalty area

Key stroke			
1	**2**	**3**	***4***
Player	Area of Pitch	**Goal Kick (g)**	**Successful (s)** If the ball clears the half way line without bouncing and stays in play or is played short to a team mate.
			Unsuccessful (u) If the ball does not clear the half way line, goes straight out of play or is a misplaced short pass.

3.4.7 Pass

A 'pass' is defined as the attempt by a player to relinquish possession of the ball by giving possession to another player on the analysed team. Typically this is achieved by intentionally kicking or heading the ball to a team-mate. Occasionally this might involve another body part but the intent to give possession to a specific team-mate must be demonstrated. The pass is categorised according to the difficulty associated with it, its contribution within the game and its outcome (Table 3.10)

Table 3.10: The pass as defined by difficulty, contribution within the game and outcome

<table>
<tr><th>Difficulty</th><th>Contribution within the game</th><th>Outcome</th></tr>
<tr><td rowspan="2">Easy
When there is no possibility of the ball being intercepted by an opposition player and the passer of the ball is under little time pressure from the opposition</td><td>Non-Key
A pass that does not directly set up an attacking move</td><td rowspan="2">Successful
A pass that can be touched by a fellow member of the studied team.</td></tr>
<tr><td rowspan="2">Key
A pass that does directly set up an attacking move</td></tr>
<tr><td rowspan="2">Difficult
When there is a possibility of the ball being intercepted by an opposition player if the pass is hit incorrectly or there is time pressure from the opposition</td><td rowspan="2">Unsuccessful
A pass that can not be touched by a fellow member of the team</td></tr>
<tr><td>Assist
The pass to the goal scorer (is a particular type of key pass.)</td></tr>
</table>

The coding structure of how a pass was entered into the system can be seen in Table 3.11. The pass is coded differently to the other performance indicators, with the outcome being coded before the type of pass that was attempted. This was due to the high amount of detail that the pass was looked into and the limitations of the analysis package used.

Table 3.11: The coding structure for the pass

Key stroke			
1	*2*	*3*	*4*
Player	Area of Pitch	**Successful Pass (p)**	**Easy Non-Key Foot (e)**
			Difficult Non-Key Foot (d)
			Easy Key Foot (f)
			Difficult Key Foot (k)
			Easy Non-Key Head (n)
			Difficult Non-Key Head (h)
			Easy Key Head (1)
			Difficult Key Head (2)
			Easy Non-Key Chest (3)
		Unsuccessful Pass (u)	**Difficult Non-Key Chest (4)**
			Easy Key Chest (5)
			Difficult Key Chest (6)
			Easy Assist Foot (a)
			Difficult Assist Foot (7)
			Easy Assist Head (8)
			Difficult Assist Head (9)
			Easy Assist Chest (c)
			Difficult Assist Chest (0)

3.4.8 Dribbling the ball

A player is classed to have dribbled the ball if he runs with the ball at his feet and either enters another area of the pitch or attempts to beat an opposition player.

Table 3.12: Codes used when member of the studied team dribbles with the ball

Key stroke			
1	**2**	**3**	***4***
Player	Area of Pitch	**Dribbling (d)**	**Finishing Area of Pitch (as ks 2)**

The area of the pitch that the run finishes in is the modifier for dribbling. However, the result of the dribble is coded separately e.g. whether the ball is passed or maybe lost at the end of the dribble. This results in what appears to be a double possession of the ball by the same player when in fact only one possession existed. This was resolved by recoding the data in the SPSS package.

3.4.9 Attempts at goal

An attempt at goal is defined as when one of the player's takes a shot at goal in an attempt to score. It is coded irrespective of whether it is on target or not.

Table 3.13: Codes used when a player makes an attempt at goal

<table>
<tr><td colspan="4">Key stroke</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td rowspan="4">Player</td><td rowspan="4">Area of Pitch</td><td rowspan="2">Foot (f)</td><td>Goal (g)</td></tr>
<tr><td rowspan="2">On Target (t)</td></tr>
<tr><td rowspan="2">Head (h)</td></tr>
<tr><td>Off Target (w)</td></tr>
<tr><td colspan="3"></td><td>Blocked (b)</td></tr>
</table>

3.4.10 Clearance

A clearance was defined as an attempt to clear the ball while a goal threat is present without any real intention to pass the ball to a team-mate, this applies to the goalkeeper as well as outfield players.

Table 3.14: Codes used when a member of the studied team makes a clearance

<table>
<tr><th colspan="4">Key stroke</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td rowspan="4">Player</td><td rowspan="4">Area of Pitch</td><td>Head (h)</td><td rowspan="2">Successful (s)
The ball is cleared from a potentially dangerous situation either into touch or away from the attacking members of the opposition team.
The ball is cleared to an opposition player who is not involved with the attacking period of play from the opposition, for example the teams centre back who has stayed back.</td></tr>
<tr><td>Punch (p)</td></tr>
<tr><td>Foot (f)</td><td rowspan="2">Unsuccessful (u)
The ball is not cleared from a potentially dangerous situation effectively. For example if the ball falls to one of the attacking players from the opposition and they can maintain the attack then the danger has not been cleared effectively.</td></tr>
<tr><td colspan="2"></td></tr>
</table>

3.4.11 Save

This is defined as where the goalkeeper uses any part of his body in an attempt to stop a shot on his goal entering into the net. This does not include crosses that are caught by the goalkeeper, as these are classed as interceptions.

Table 3.15: Codes used when the goalkeeper makes a save

Key stroke			
1	*2*	*3*	*4*
Player	Area of Pitch	**Save (s)**	**Successful (s)** Any time a goalkeeper picks up the ball or touches it with his hands, for example claiming crosses or stopping shots.
			Unsuccessful (u) When a goal is conceded.

3.4.12 Substitutions

A substitution was defined as a replacement made during the game with one of the outfield players being replaced by a reserve player. This was noted as it could have resulted in a change of formation for the team. Also, when individual analysis on the players is performed it allows easier assessment of the games they participated in.

Table 3.16: Codes used when a player is substituted

Key stroke		
1	*2*	*3*
Substitution (s)	**Player being replaced (r)**	**Player being bought on (o)**

Once the matches had been analysed using the above coding structure, specific performance indicators were selected for subsequent analysis. These included variables related to possession, passing and attempts at goal, namely, periods of possession in relation to areas of the pitch, player contributions in these areas, the level of difficulty of passes and an analysis of shots and goals.

3.5 Reliability of notation system

Hughes *et al.* (2002) found that eighty-five percent of notation papers did not perform a satisfactory reliability study. Indeed, Hughes *et al.* (2002) observed that a key component in any research design that employs new equipment is the repeatability and accuracy of this apparatus and therefore it was important to perform an appropriate reliability test in this thesis. Intra- and inter-operator reliabilities were calculated using the percentage error for each variable which Hughes *et al.* (2002) suggest allow a powerful image of the error for each variable. The intra-reliability test examines the ability of the same observer to accurately code the same passage of play twice, whereas the inter-reliability study assesses an external observer's ability to use the system to successfully code a passage of play when compared to the experts coding.

In the current thesis a two part intra- and inter-observer reliability test was conducted. The initial tests used the same fifteen minutes of match footage randomly selected from the total of the twenty-one observed matches. The initial intra-observer reliability (repeatability) test was carried out with the experimenter (experienced observer, over 100 hours on the system) analysing the selected footage on two occasions. This was conducted either side of a six week gap to prevent any possibility of memory affecting the results. In order to ensure standardisation every effort was made to replicate the conditions between the first and second analyses. The intra-observer reliability was then calculated using the percentage error for each performance indicator. Once the initial test had been performed a second intra-

reliability test was carried out with the observer analysing the same two games twice. The results from the second test were then compared to the first in order to establish whether the initial test had provided an accurate assessment of the systems reliability levels.

Table 3.17 Categorisation of analytical errors found when using the analysis system

Type of Error	Definition
Definitional Errors	Operational definitions were unclear to the observer i.e. areas of doubt, thought to be due to the observer not being completely familiar with the definitions and coding structure. For example, coding an easy non-key pass when it was a difficult non-key pass.
Operational Errors	The observer knew what to code but used the wrong code or button to label an event. This can be overcome through observer training.
Observational Errors	Events missed by the observer and therefore un-coded. This type of error can be attributed to the level of observer competence and their relative soccer knowledge.

The initial inter-observer reliability test involved two researchers (fifteen years of experience in soccer each) analysing the selected 15 minutes of video footage. Prior to analysis, they were given a two-hour training session on how to use the Observer system and an explanation of the configuration. The data from these two researchers was compared with the experienced observer's to examine discrepancies. Again, separate analyses were compared by calculating the percentage error for each performance indicator. The errors made were categorised as operational, observational or definitional errors (Table 3.17 for definitions). The results of this analysis established where the two inexperienced analysts had gaps in their knowledge. A subsequent questionnaire and interviews with the two analysts identified further training needs. Subsequent training for a further four hours with

special attention paid to areas of the coding structure that had caused problems ensued. The second inter-reliability test was then performed on the same two matches used in the intra-reliability test to assess the reliability of the definitions and coding structure.

3.6 Procedures

Data was collected for notational analysis via a four stage procedure. Stage one involved recording soccer games onto a CD. Each game was initially recorded from either Terrestrial or Satellite television onto a normal VHS tape using a Panasonic video recorder and television. The game was then played from the video tape onto a Dell PC computer via a Clipmaster MPEG converter (Fast Multimedia, 1999) using the Dazzle MovieStar Digital Video Creator version 4.22 software (Fast Multimedia, 1999). This process converts the film into MPEG format which is stored on the video hard drive. This can then be written to a CD using the Roxio Easy CD Creator 5 programme (Roxio, 2001). The limited amount of data a CD can hold meant that each half had to be recorded onto separate CDs.

Stage two involved devising a computerised notation system using the Noldus Observer Video-Pro behavioural measurement package (Noldus Information Technology, 1996). To assist a unique configuration/coding system was designed which allowed the performance indicators to be coded into the system using a one or two key entry. To make the system user-friendly, whenever possible, each code resembled the initial of the performance indicator it represented (e.g. pass = p). Once a configuration is designed this can then be used to analyse the game using the Observer package.

The way that the Observer software is designed allows the configuration to have four levels: subjects, behaviours, modifier 1 and modifier 2. Each level allows a separate piece of information to be entered into the system so when an action is input into the

system there are four pieces of information that can be entered. In the subject level two numbers are entered which code a particular players position in the team (e.g. 16 = Central Midfielder1); in the behaviour level a letter is entered to code the action the player performs (e.g. t = tackle); in the first modifier level a number or letter is entered to code the area of the pitch that the player receives the ball (e.g. 3 = Central Pre-Defensive area). Finally, in the second modifier level a number or letter is entered to code the outcome or difficulty of the action that the player performs (e.g. s = successful foot). To provide an example, if a player numbered 16 makes a tackle in area 3 of the pitch that has been carried out with his foot and is successful then the information would be entered as shown in Table 3.18.

Table 3.18: A data entry example using the analysis system

	Subject	Behaviour	Modifier 1	Modifier 2
Key Press	16	t	3	s
Meaning	Player Number	Tackle	Middle of Pre-Defensive Area	Successful Foot

Once a half has been analysed the third stage is to transform the data from the format that it is produced in the Observer package into a format that can then be analysed in SPSS 10.0 (SPSS Inc). The text file that is produced by the Observer system is opened in Word and the text needs to be recoded into numbers so the data can be input into SPSS (SPSS Inc). For the first half that was analysed, a macro was recorded in Word which transformed all the text codes into numbers. Once this initial macro was recorded it could then be utilised on all the other games that were analysed. After each half of play had been transformed into numerical data it was then transferred from Word into SPSS (SPSS Inc) and all the appropriate labels were given to each individual number. Once the data from all twenty-one games had been copied into the SPSS file over 25,000 lines worth of data had been collected. Detailed analysis could then be performed on the data.

3.7 Data analysis

Analysis of data was conducted in four stages. Firstly, intra- and inter- reliability measures were performed. Secondly, differences in general patterns of play as a function of the nature of the competition participated in i.e. European or domestic matches were assessed by analysing ball movements over the designated areas of the soccer field. It was hypothesised that possession statistics in the different areas of the pitch would be indicative of different playing styles which would give an insight into the tactical strategies used. It was thought that there would be a difference in this pattern of play between the two competitions which may reflect the strength of the opposition forcing the team to play in certain areas and/or a conscious decision by the team to play the ball into areas possibly to expose the opposition's weaknesses. To further examine the possession data individual player's possessions in the different areas of the field were also examined. It was thought that individual differences may clarify or further discriminate between the team's strategic movement of the ball between areas and differences due to the opposition forcing the team to react. This differentiation between choice of action (self imposed) and reaction to the opponent (imposed upon) was considered particularly challenging since no communication was available with the analysed team. This would mean that any conclusions made about the data could only be inferences. A final analysis related to possession was to compare the way some player's passed the ball. Passes were classified as either easy or difficult. It was hypothesised that differences in the ratio of easy to difficult passes between different matches may further indicate strategy changes. This ratio again could be determined by the opposition's ability to limit the passing options.

Finally analyses of possessions leading to a shot at goal were compared between the two competitions. It was thought that goal scoring chances could have been created either by a series of passes or by a more direct long ball approach. Previous analyses of British teams have suggested the latter approach to be favoured. This needed to be tested as previous analyses were somewhat dated. Also it was hypothesised that the

two approaches could have been used in the different competitions as previous studies have suggested European sides favour the passing option compared to the direct route favoured by the British sides (Yamanaka *et al.* 1993). It was thought, therefore, that one possibility was for the team to adopt European and British styles when playing in the two different competitions. The data analysed was in the form of frequencies within specific areas and consequently Chi-square analyses were used to determine probability estimates of observed cell frequencies matching expected ones in comparisons between European and domestic matches.

4 Results

4.1 Reliability

The observational analysis system was tested for both internal consistency (intra-reliability) and external consistency (inter-reliability). The reliability test was conducted in two parts. The first stage involved analysing a fifteen minute period of play from a randomly selected match. The second repeated the procedure with analysis of two randomly selected games rather than the initial fifteen minutes. The initial test was conducted to assess the training given to the two inexperienced observers (inter-reliability) and identify any areas in which they were weak so further training could be administered before the second testing procedure. The experienced observer undertook the same procedure so their performance in the initial test could be compared to that of the second where a much longer period of time was used in order to assess whether a fifteen minute period of analysis was long enough to assess the intra-reliability of the system. The initial intra-reliability test, which examines the ability of the one observer to accurately code the same passage of play twice, compared two fifteen minute trials from the highly experienced observer with a six week period in between. If the system was reliable small differences between the two trials would be expected and Table 4.1 indicates this with there being over a 99% success rate. Of the ten mistakes made over the two trials, nine of them were observational and one operational. No definitional errors were observed which suggests a well designed configuration with clear definitions for each performance indicator. This is of great importance to the reliability of the system as observational and operational errors can be reduced through more extensive training or simply by greater concentration from the observer when coding. It is the structure of the configuration and the way that each performance indicator is defined that underpins the systems ability to be used reliably. If an observer has a clear definition for every event they have to code throughout the game, and no unclear operational definitions can be found in the definitions, each observer with sufficient training should be able

to use the system in exactly the same way. Nevertheless, further analysis was conducted to investigate where the errors occurred.

Table 4.1: Initial intra-reliability test on the analysis system

	Definitional Errors	Operational Errors	Observational Errors	Total Errors	Total Entries	Percent Correct
Trial 1	0	0	5	5	893	99.44
Trial 2	0	1	4	5	893	99.44

Table 4.2 shows that the highly trained analyst recorded low errors for all variables (≤ 4%). The area of the pitch was the most common mistake, mainly due to the number of times this has to be coded, but also, in part, due to the potential difficulty in identifying which area of the pitch the player is in when there are no pitch markings to aid the coder.

Table 4.2: Area of errors in the initial intra-reliability test in relation to performance indicators in soccer

Performance Indicators	Number of Mistakes	Number of Entries	Percentage of Errors
Area of Pitch	4	226	1.77
Outcome of Tackle	1	25	4.00
Outcome of Pass	1	112	0.89
Team Possession	1	67	1.49
Type of Pass	1	112	0.89

The initial inter-reliability test compared the results of the two less experienced analysts with the highly trained analyst. It is important to express the intention of the two inter-reliability tests. Whilst an inter-reliability test is normally used to assess

whether a notational analysis system can reliably be used by more than one analyst, this was not the intention of this test. The complicated nature of the analysis system utilised in the thesis meant that without extensive training it would be unlikely that the inexperienced observers could achieve high levels of reliability for data entry. Time constraints meant that this was simply not feasible. However, the fact that only one analyst was going to be used to analyse all the matches meant that it was not important to assess whether other analysts could use the system in a reliable fashion to code a match. The intention of this inter-reliability test was to assess the reliability of the definitions and structure of the coding system. The level of definitional errors portray this as operational and observational errors assess the observer's ability to enter data correctly. Definitional errors are areas of doubt where the external observer is not completely familiar with the definitions and coding structure. If each performance indictor has been defined clearly and the coding structure is well designed these errors should be low which would reflect a reliable coding structure that could be implemented by other analysts with extensive training. The initial inter-reliability test was performed to identify any areas of the coding structure where sufficient training had not been provided.

The initial reliability test proved that, predictably, a much higher error rate was present for less experienced analysts (Table 4.3) compared to the highly trained analyst (Table 4.1). The relatively low level of definitional errors (2.46%) do initially suggest that the configuration was clear and easy to use and with additional training these errors are expected to reduced further. The higher incidence of operational (5.15%) and observational (7.73%) errors are almost certainly due to the complexity of the coding structure, but these too should reduce with training as the observers understanding of the system increases. In order to assess where errors occurred during analysis and identify areas where further training was required each error was categorised in relation to the performance indictor in which it occurred (Table 4.4). This suggests that training was not sufficient for the correct coding of a dribble (100% error) or a save (100% and 66.67% error) as the error rates were so high. Furthermore,

some ambiguity appeared for the tackle (particularly the less experienced participant A with 44% errors). This error occurred when the tackle was missed, it should have been coded as attempted but unsuccessful whereas this participant did not code anything. Another training issue was raised by the high incidence of errors by one participant but not the other (loss of possession 75% and 0%). Further analysis also revealed that the main cause for definitional errors was when deciding what type of pass each player attempted (16.07% and 21.43% error rates). Feedback from a post event questionnaire and interviews attributed the majority of blame to poor training in these areas with the observers expressing doubts on how to enter the data into the system correctly and in some cases the fact that they had to enter the data at all. Consequently the observers were retrained for four hours each, with extra attention placed upon these specific errors.

Table 4.3: Initial inter-reliability test on the analysis system

	Definitional Errors	Operational Errors	Observational Errors	Total Errors	Total Entries	Percent Correct
Less experienced A	21	47	73	141	893	84.21
Less experienced B	23	45	65	133	893	85.11

It is evident when breaking down the analysis into each individual performance indicator that fifteen minutes is not sufficient when attempting to address some of the reliability issues on analysis systems raised by Hughes *et al.* (2002) due to the low number of some of these indicators (six indicators had less than 25 entries in the fifteen minutes). Once the initial reliability tests were performed, each observer analysed two randomly selected games increasing the frequency of indicators which provided a more accurate assessment on the reliability of the coding structure.

Table 4.4: Area of errors in the initial inter-reliability test in relation to performance indicators in soccer

Performance Indicator	Number of Entries	Number of Mistakes		Percentage of Errors	
		Less Experienced A	Less Experienced B	Less Experienced A	Less Experienced B
Player	227	4	3	1.76	1.32
Pass	112	3	1	2.68	0.89
Outcome of Pass	112	3	6	2.68	5.36
Type of Pass	112	18	24	16.07	21.43
Area of Pitch	226	25	9	11.06	3.98
Tackle	25	11	5	44.00	20.00
Outcome of Tackle	25	3	1	12.00	4.00
Gaining of Possession	67	8	12	11.94	17.91
Loss of Possession	4	0	3	0.00	75.00
Result of Dribble	1	1	1	100.00	100.00
Clearance	5	2	1	40.00	20.00
Save	3	3	2	100.00	66.67
Result of Set Piece	6	1	0	16.67	0.00
Off Sides	2	1	0	50.00	0.00

The second intra-reliability test produced very similar results to that of the first despite the much larger sample size (Table 4.5 and 4.1). The total number of mistakes throughout the game was extremely low once again with over a 99% success rate in each of the two trials. The number of definitional errors was almost non-existent with an error rate of 0.08%. The number of observational (0.27% error rate) and operational (0.91% error rate) errors were also low. The fact that the definitional errors are so low implies that the coding system is well defined and structured. Additionally, the low number of observational and operational definitions suggests that with sufficient knowledge of the data entry process the system could be used by other observers to reliably code a match.

Table 4.5 Second intra-reliability test on the analysis system

	Definitional Errors	Operational Errors	Observational Errors	Total Errors	Total Entries	Percent Correct
Trial 1	2	13	29	44	9103	99.52
Trial 2	5	12	22	39	9103	99.57

The performance indicators in which each mistake was made can be seen in Table 4.6. It is clear from this that the percentage errors have decreased in all performance indicators when a larger sample size was used for analysis (two games compared to fifteen minutes), except for the type of pass performance indicator, which has risen from 0.89% to 1.39%. Five mistakes were made when coding the occurrence of a tackle in the second reliability test whereas this mistake never occurred in the first analysis. This highlights the effect that a lack of data can have when performing a reliability test. Only 25 tackles were coded in the first analysis whereas 290 were coded in the second analysis. The initial test did not test sufficient amounts of data for each performance indicator to ensure that a reliable picture was being produced. Indicators such as the area of the pitch, passing or team possession remained

relatively similar for the two tests because they occurred frequently throughout the analysis, so it took a shorter period of time to generate an accurate picture of their levels of reliability. The low frequency of the other studied indicators meant their reliability could not be assessed accurately and a larger sample size was required to achieve this. This will also apply to the inter-reliability test and it should be evident that the indicators which appear less frequently in the initial analysis have settled down to more stable values. Table 4.6 demonstrates this fact with each performance indicator error level stabilising at fewer than 2%. This indicates that sufficient data was collated for the intra-reliability study and the system is reliable.

Table 4.6: Area of errors in the second intra-reliability test in relation to performance indicators in soccer

Performance Indicators	Number of Mistakes	Number of Entries	Percentage of Errors
Area of Pitch	25	2385	1.05
Outcome of Tackle	3	290	1.03
Outcome of Pass	4	934	0.43
Team Possession	10	812	1.23
Type of Pass	13	934	1.39
Tackle	5	290	1.72

The second inter-reliability test demonstrated a considerable improvement in the less experienced observer's ability to use the analysis system. Both analysts improved by approximately 11% from a success rate of around 85% to 96% (Table 4.7 and 4.3). The level of definitional errors decreased from 2.46% to 0.55% which backs up the findings from the intra-reliability study that the system is well defined and structured.

Surprisingly the operational errors (1.4% down from 5.15%) and observational errors (1.72% down from 7.73%) decreased substantially. This suggests that the extra four hours training administered to the observers was very efficient and all the problem areas in the training were correctly identified after the initial inter-reliability test.

Table 4.7 Second inter-reliability test on the analysis system

	Definitional Errors	Operational Errors	Observational Errors	Total Errors	Total Entries	Percent Correct
Less experienced A	57	120	171	384	9103	95.78
Less experienced B	43	135	143	321	9103	96.47

When analysing where each error occurred in relation to the performance indicators it is noticeable how the majority of errors for an indicator have stabilised between a 1 and 5% error rate (Table 4.8). The only two indicators that had an error rate over 5% was the result of a dribble, which can be attributed to the fact that only 13 of these actions occurred throughout the 2 matches and loss of possession which is an area that may have required further training. The reason for the errors stabilising has already been discussed in relation to the intra-reliability test and the same applies with this test. It is the low percentage of the error rates for each indicator that is the most interesting discovery. It would appear that the training administered was very successful and with only a few more hours training the less experienced observers may have been able to code a match as reliably as the more experienced observer. Both the intra- and inter-reliability studies show very low levels of definitional errors which indicates that the definitions and coding structure utilised by the study are reliable. Furthermore, the low error rates in the second inter-reliability study suggest that with sufficient training this system would produce reliable results if different observers were utilised in the analysis procedure.

Table 4.8: Area of errors in the second inter-reliability test in relation to performance indicators in soccer

Performance Indicator	Number of Entries	Number of Mistakes		Percentage of Errors	
		Less Experienced A	Less Experienced B	Less Experienced A	Less Experienced B
Player	2385	59	32	2.47	1.34
Pass	934	7	13	0.75	1.39
Outcome of Pass	934	26	21	2.78	2.25
Type of Pass	934	42	37	4.50	3.96
Area of Pitch	2385	97	79	4.07	3.31
Tackle	290	11	5	3.79	1.72
Outcome of Tackle	290	7	12	2.41	4.14
Gaining of Possession	812	25	28	3.08	3.45
Loss of Possession	69	4	5	5.80	7.25
Result of Dribble	13	1	2	7.69	15.38
Clearance	93	7	4	7.53	4.30
Save	12	0	0	0.00	0.00
Result of Set Piece	82	3	2	3.66	2.44
Off Sides	10	0	0	0.00	0.00

4.2 Analysis of soccer strategies

Due to the fewer European games played over the season it was not possible to analyse the same number of European and domestic games. Rather than omitting three of the domestic games to balance the games studied to nine each all the available information was used in order to create as accurate a picture as possible of the team's style and pattern of play by analysing the maximum amount of matches that were available. The larger the data set studied the more reliable the results become as anomalies have less of an effect and consequently there is a greater chance of generating an accurate assessment of the team's tactics (Thomas and Nelson, 2001). The results were presented as frequencies and percentages to allow an accurate comparison between the two competitions (percentages) and give a true perspective of the data (frequencies). When analysing shots, ratios of shots taken to a goal scored were used since shots taken have been shown to be a performance indicator of importance (Bishovets.*et al.*, 1993; Yamanka *et al.*, 1993; Luhtanen, 2001).

Given the objective of generating playing patterns in relation to each competition several analyses were conducted. Firstly, each area of the pitch was analysed (the time the ball spent in each area and the frequency of ball entries) to ascertain which areas of the pitch were used most frequently. This was thought to be indicative of the tactics the team employed e.g. a relatively high number of ball entries into wide areas would be seen if attacking down the wings was a tactical ploy. Whilst there is no way of knowing what constitutes a high frequency of ball entries (this is a case study) tactical differences between the competitions could be seen through a comparative analysis. Secondly, individual player analyses of their contributions (number of possessions) and pass type (easy or difficult) in each area of the pitch were compared to see if players had different responsibilities in each competition, again thought to reflect the tactical style of the team. Finally, a shot analysis (goals scored and scoring opportunities) compared both competitions for where moves originated and the

number of passes leading to the shot. This could also indicate tactical differences between the competitions.

4.3 Time spent in each area of the pitch by the ball

Initially, the frequency of ball entries into each area of the pitch when the team was in possession was examined. This has been the subject of much debate, and Pollard and Reep (1997) for example suggest that the more times the ball enters the danger areas the higher the chance of scoring a goal by an attacking team.

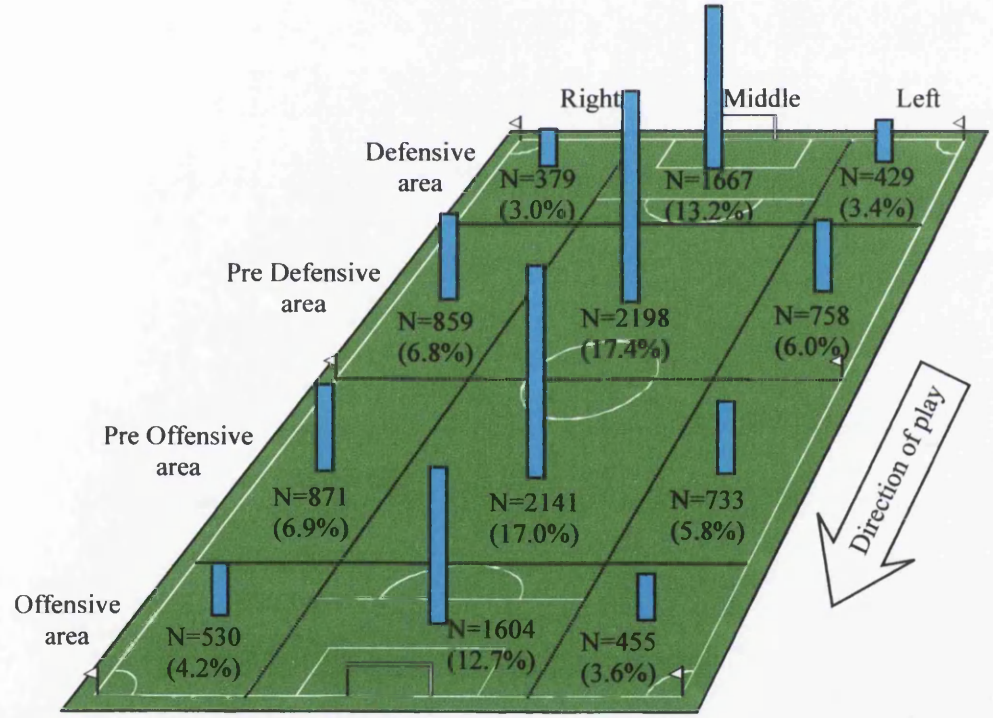

Figure 4.1: Frequency and percentage of ball entries into each area of the pitch during the team's possession

Figure 4.1 shows the predominance of ball entries into central (pre-defensive/pre-offensive) areas of the pitch (59.9%) compared to defensive (19.6%) and offensive areas (20.5%), and also the middle area (60.3%) compared to the wings (39.7%),

respectively. It should be noted, however, that this finding should be interpreted with respect to the fact that some areas are physically bigger than others (Figure. 3.1). It was noted that the team played the ball into the important middle offensive area 1604 times (12.7%) in 21 matches (Figure 4.1). With no comparative data available to test whether this was a particularly strong or weak incidence rate the data was divided into games played against European and domestic opposition. A Chi-squared test significantly demonstrated that the ball entered each area of the pitch differently in European compared to domestic games ($P < 0.05$, Figure 4.2). It appeared that the team attacked more down the right hand side of the pitch in domestic games (right offensive and pre-offensive frequencies above their expected levels) compared to European games. This tentatively suggests a difference in the pattern of play between the two competitions.

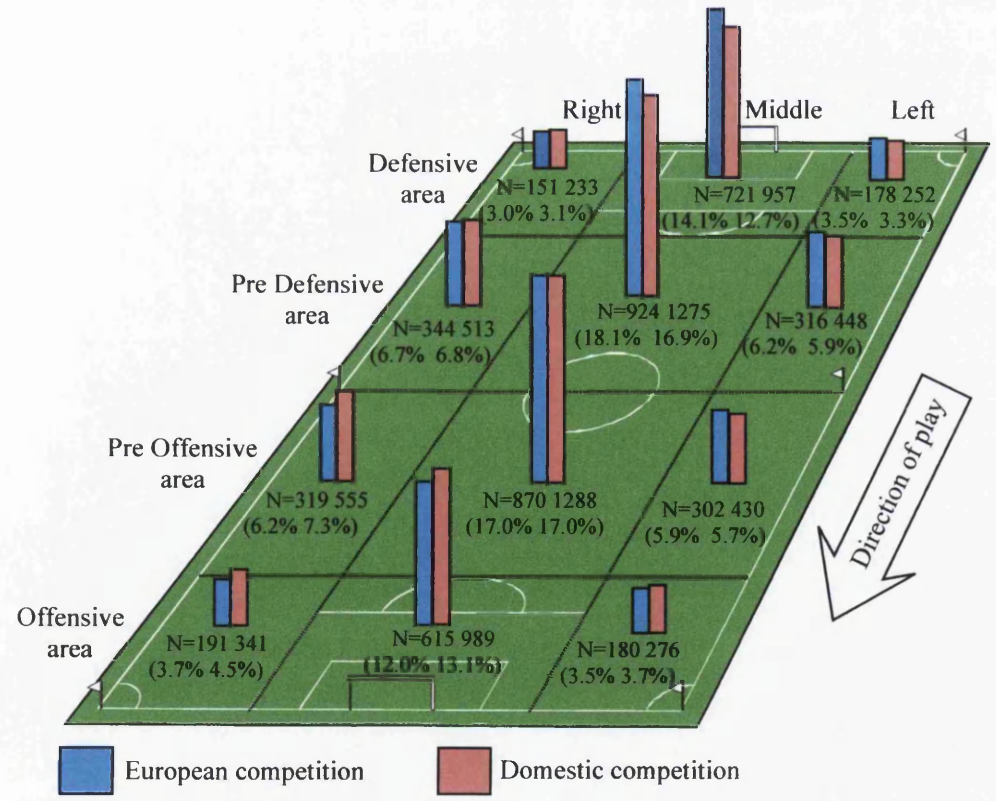

Figure 4.2: Number and percentage of ball entries into each area of the pitch during possession in European and domestic competitions

The previous analysis did not account for potential differences occurring depending on whether matches were played at home or away, or for the result of the match. A Chi-squared test showed that the difference in ball entries between European and domestic matches was only significant for matches played at home ($p < 0.001$) but not away ($p = 0.13$) and when matches were drawn ($p < 0.001$) but not won ($p = 0.13$) or lost ($p = 0.53$) (see Appendices 2 through to 6 for frequency data). These findings, however, are based on smaller sample sizes due to the necessary selection of only the appropriate matches in each case. These findings (related to the confounding variables venue and result) need to be treated with caution but suggest future analyses of possession data needs to incorporate these variables. Consequently all of the possession data analyses presented here needs to be interpreted with caution as differences between European and domestic matches may be influenced by the confounding variables mentioned.

Whilst the frequency of ball entries into various areas of the pitch gives some indication of possession patterns it does not provide a comprehensive indication of strategy. The period of each possession within an area may therefore also give further information about patterns of play. Hence the team's possessions were calculated with respect to the area in which the ball travelled and this allowed the time the ball spent in each area of the pitch to be derived. Figure 4.3 shows that the ball tends to stay in an area for between 3 to 5 seconds, except in the middle defensive area (6.3 seconds) and the middle offensive area (1 second). These discrepant results may be explained by, respectively, the tendency for the goalkeeper to hold on to the ball in his area and the greater likelihood of immediately taking a shot at goal in the opposition's penalty area. The different patterns exhibited between European and domestic matches begin in the pre-defensive areas where the ball tends to be held onto longer in European matches. In the pre-offensive areas, however, the ball tends to stay on the right of the field longer in Europe but longer on the left in domestic competitions. In both the left and right offensive areas the ball tends to be held onto by the team for a relatively long duration.

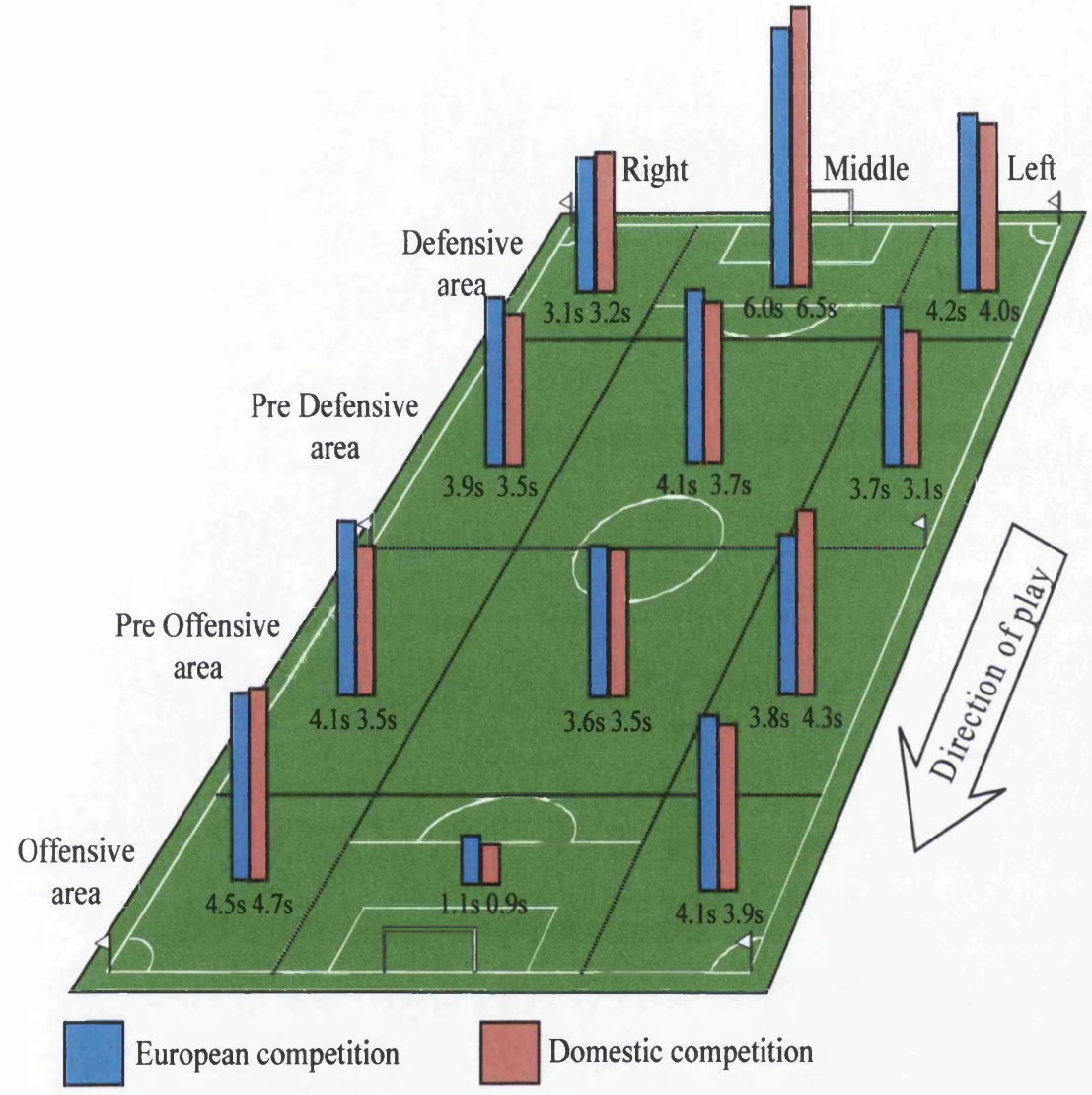

Figure 4.3: Time spent by the ball in each area of the pitch during possession in European and domestic competitions

Data from Figure 4.2 (number of occasions the ball is in an area) and Figure 4.3 (mean time the ball is in an area) was subsequently combined to calculate the proportionate time the ball spends in one area relative to the other areas (Figure 4.4).

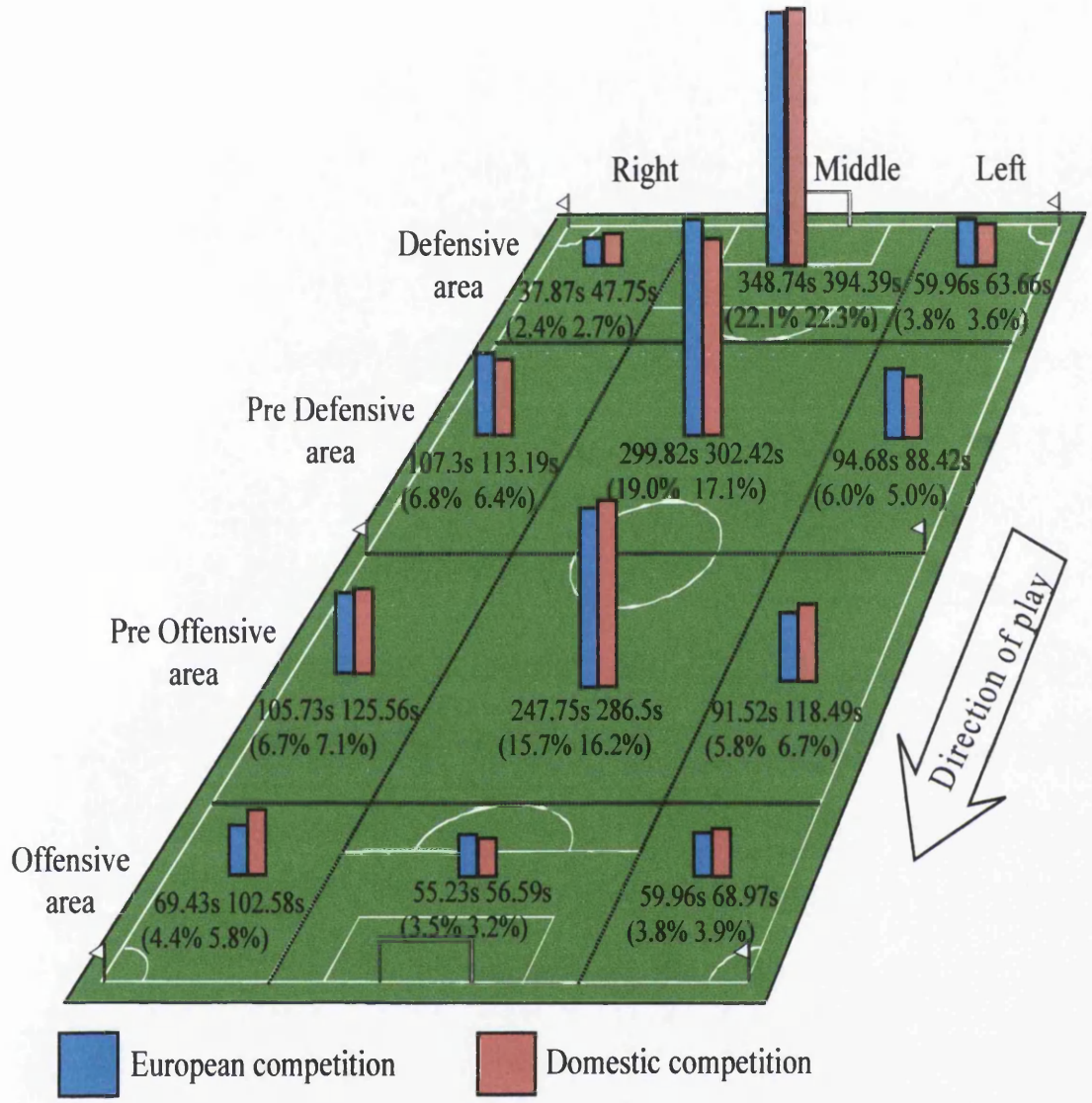

Figure 4.4: The number and percentage of seconds the ball spends in each area of the pitch per game during possession in European and domestic competitions

From the subsequent findings the most prominent observation was that in Europe the ball spends more time in the pre-defensive areas (31.8%) and less in the pre-offensive areas (28.2%) compared to the reverse in domestic matches (28.5% and 30% respectively). A large difference can also be seen in the right offensive area, where in

domestic competitions the ball spends 5.8% of the time compared to only 4.4% in Europe. This pattern is not repeated on the left wing in domestic (3.9%) or European (3.8%) matches. To further investigate the above findings an analysis of player movements was performed to establish if further evidence of strategy changes could be identified.

4.4 Player contributions in areas of the pitch

Due to the large data set analyses were confined to the players who took part in the majority of games sampled in relation to their designated playing position. Since the focus of investigation was tactical play the main individual analysis examined players who contributed in the middle areas of the pitch. The first analysis concerned the central midfield players (n =4).

Table 4.9: The number and percentage of contributions made by central midfield players in the middle areas of the pitch during possession in European and domestic competition

Middle areas	Player 1		Player 2		Player 3		Player 4	
	Europe	Domestic	Europe	Domestic	Europe	Domestic	Europe	Domestic
Defensive	37 (4.1%)	41 (3.3%)	26 (4.8%)	46 (5.0%)	72 (10.1%)	106 (11.3%)	27 (10.0%)	45 (7.2%)
Pre-defensive	260 (29.0%)	301 (24.5%)	165 (30.3%)	238 (26.1%)	278 (38.9%)	302 (32.2%)	107 (39.8%)	183 (29.5%)
Pre-offensive	306 (34.2%)	380 (30.9%)	163 (30.1%)	284 (31.1%)	169 (23.6%)	227 (24.2%)	65 (24.2%)	184 (29.7%)
Offensive	49 (5.5%)	97 (7.9%)	55 (10.1%)	101 (11.1%)	28 (3.9%)	56 (6.05%)	12 (4.3%)	39 (6.3%)

Only one of the four players was found to have made a significantly different number of contributions between European and domestic fixtures (player 4, $P < 0.01$) where the player was observed to perform comparatively more defensively in Europe (Table 4.9). Like the other three players, the majority of contributions were made in the middle areas, in particular the pre-offensive and pre-defensive areas. This evidence would suggest that the demands of the position were being met by the players. It was also evident that these players operated differently, with players 1 and 2 tending to make more contributions in offensive positions, while players 3 and 4 made more contributions in defensive positions suggesting players may individualise their role within the confines of the position. From the analysis of the four central players it seems that the team are more defensive in Europe than in the domestic games. All four players are in action more in the middle pre-defensive area in Europe suggesting that the central midfield players have been requested tactically to protect the back four in this competition, whereas domestically they do not appear to have as much defensive responsibility.

In order to further explore the previous finding of the current thesis, showing the tendency to attack more down the right hand side of the pitch in domestic fixtures, the next analysis examined the wide players. The analysis revealed that, as expected, the designated right back performed significantly more on the right side of the pitch compared to the left, but also played differently in Europe compared to domestic matches (P <0.001). This was due to an increased defensive role in Europe (13.2% of contributions in the right defensive, 31.6% in the right pre-defensive area compared to 8.5% and 21.3% domestically, Table 4.10). This relates to the previous findings on the teams more defensive strategy in Europe. The right midfielder (Table 4.11), however, made a very similar number of contributions in each area in Europe and domestic competitions ($p = 0.951$). This would suggest that the team's offensive patterns do not differ significantly between Europe and domestic competition down the right hand side of the pitch.

Table 4.10: Frequency of contributions by the right back in the different areas of the pitch in European and domestic matches

Area		Competition		
		European Cup	Domestic	Total
Left Defensive Area	Count	0	14	14
	Expected Count	3.5	10.5	14.0
	% within COMP	.0%	2.4%	1.8%
Middle Defensive Area	Count	20	65	85
	Expected Count	21.1	63.9	85.0
	% within COMP	10.5%	11.3%	11.1%
Right Defensive Area	Count	25	49	74
	Expected Count	18.4	55.6	74.0
	% within COMP	13.2%	8.5%	9.7%
Left Pre-Defensive Area	Count	2	30	32
	Expected Count	8.0	24.0	32.0
	% within COMP	1.1%	5.2%	4.2%
Middle Pre-Defensive Area	Count	16	55	71
	Expected Count	17.7	53.3	71.0
	% within COMP	8.4%	9.6%	9.3%
Right Pre-Defensive Area	Count	60	122	182
	Expected Count	45.3	136.7	182.0
	% within COMP	31.6%	21.3%	23.8%
Left Pre-Offensive Area	Count	0	29	29
	Expected Count	7.2	21.8	29.0
	% within COMP	.0%	5.1%	3.8%
Middle Pre-Offensive Area	Count	10	30	40
	Expected Count	9.9	30.1	40.0
	% within COMP	5.3%	5.2%	5.2%
Right Pre-Offensive Area	Count	33	111	144
	Expected Count	35.8	108.2	144.0
	% within COMP	17.4%	19.3%	18.8%
Left Offensive Area	Count	0	10	10
	Expected Count	2.5	7.5	10.0
	% within COMP	.0%	1.7%	1.3%
Middle Offensive Area	Count	1	13	14
	Expected Count	3.5	10.5	14.0
	% within COMP	.5%	2.3%	1.8%
Right Offensive Area	Count	23	46	69
	Expected Count	17.2	51.8	69.0
	% within COMP	12.1%	8.0%	9.0%
Total	Count	190	574	764
	Expected Count	190.0	574.0	764.0
	% within COMP	100.0%	100.0%	100.0%

Table 4.11: Frequency of contributions by the right midfield player in the different areas of the pitch in European and domestic matches

Area		Competition European Cup	Domestic	Total
Left Defensive Area	Count	2	2	4
	Expected Count	1.7	2.3	4.0
	% within COMP	.3%	.2%	.2%
Middle Defensive Area	Count	31	32	63
	Expected Count	26.5	36.5	63.0
	% within COMP	4.4%	3.3%	3.8%
Right Defensive Area	Count	28	37	65
	Expected Count	27.3	37.7	65.0
	% within COMP	4.0%	3.8%	3.9%
Left Pre-Defensive Area	Count	5	6	11
	Expected Count	4.6	6.4	11.0
	% within COMP	.7%	.6%	.7%
Middle Pre-Defensive Area	Count	83	121	204
	Expected Count	85.7	118.3	204.0
	% within COMP	11.9%	12.5%	12.3%
Right Pre-Defensive Area	Count	100	122	222
	Expected Count	93.3	128.7	222.0
	% within COMP	14.3%	12.6%	13.3%
Left Pre-Offensive Area	Count	13	18	31
	Expected Count	13.0	18.0	31.0
	% within COMP	1.9%	1.9%	1.9%
Middle Pre-Offensive Area	Count	115	171	286
	Expected Count	120.1	165.9	286.0
	% within COMP	16.5%	17.7%	17.2%
Right Pre-Offensive Area	Count	140	189	329
	Expected Count	138.2	190.8	329.0
	% within COMP	20.0%	19.6%	19.8%
Left Offensive Area	Count	38	45	83
	Expected Count	34.9	48.1	83.0
	% within COMP	5.4%	4.7%	5.0%
Middle Offensive Area	Count	54	86	140
	Expected Count	58.8	81.2	140.0
	% within COMP	7.7%	8.9%	8.4%
Right Offensive Area	Count	90	136	226
	Expected Count	94.9	131.1	226.0
	% within COMP	12.9%	14.1%	13.6%
Total	Count	699	965	1664
	Expected Count	699.0	965.0	1664.0
	% within COMP	100.0%	100.0%	100.0%

On the left side of the pitch the movement of the left back did not differ significantly when comparing Europe and domestic matches ($p = 0.073$) although it appeared that

the player was more active in both defensive areas on the left in Europe (21.2% and 23.8% compared to 17.1% and 22.4% respectively in domestic matches, Table 4.12).

Table 4.12: Frequency of contributions by the left back in the different areas of the pitch in European and domestic matches

Area		Competition European Cup	Domestic	Total
Left Defensive Area	Count	90	152	242
	Expected Count	78.1	163.9	242.0
	% within COMP	21.2%	17.1%	18.4%
Middle Defensive Area	Count	70	128	198
	Expected Count	63.9	134.1	198.0
	% within COMP	16.5%	14.4%	15.1%
Right Defensive Area	Count	1	0	1
	Expected Count	.3	.7	1.0
	% within COMP	.2%	.0%	.1%
Left Pre-Defensive Area	Count	101	199	300
	Expected Count	96.9	203.1	300.0
	% within COMP	23.8%	22.4%	22.8%
Middle Pre-Defensive Area	Count	54	111	165
	Expected Count	53.3	111.7	165.0
	% within COMP	12.7%	12.5%	12.6%
Left Pre-Offensive Area	Count	59	146	205
	Expected Count	66.2	138.8	205.0
	% within COMP	13.9%	16.4%	15.6%
Middle Pre-Offensive Area	Count	13	51	64
	Expected Count	20.7	43.3	64.0
	% within COMP	3.1%	5.7%	4.9%
Left Offensive Area	Count	21	74	95
	Expected Count	30.7	64.3	95.0
	% within COMP	5.0%	8.3%	7.2%
Middle Offensive Area	Count	15	26	41
	Expected Count	13.2	27.8	41.0
	% within COMP	3.5%	2.9%	3.1%
Right Offensive Area	Count	0	1	1
	Expected Count	.3	.7	1.0
	% within COMP	.0%	.1%	.1%
Total	Count	424	889	1313
	Expected Count	424.0	889.0	1313.0
	% within COMP	100.0%	100.0%	100.0%

The left midfielder played in the left pre-offensive area (17.8%) and the left offensive area (17.5%) significantly more ($P < 0.001$) in Europe than in domestic games (13% and 12.5% respectively). Consequently this player's role tended to be more central

(middle pre-offensive area 25.2% and middle offensive area 21.9%) in domestic soccer compared to Europe (19.5% and 16.3% respectively, see Table 4.13).

Table 4.13: Frequency of contributions by the left midfield player in the different areas of the pitch in European and domestic matches

Area		Competition European Cup	Domestic	Total
Left Defensive Area	Count	12	2	14
	Expected Count	7.4	6.6	14.0
	% within COMP	3.0%	.6%	1.8%
Middle Defensive Area	Count	12	3	15
	Expected Count	7.9	7.1	15.0
	% within COMP	3.0%	.8%	2.0%
Right Defensive Area	Count	1	0	1
	Expected Count	.5	.5	1.0
	% within COMP	.2%	.0%	.1%
Left Pre-Defensive Area	Count	34	31	65
	Expected Count	34.4	30.6	65.0
	% within COMP	8.4%	8.6%	8.5%
Middle Pre-Defensive Area	Count	45	28	73
	Expected Count	38.6	34.4	73.0
	% within COMP	11.1%	7.8%	9.5%
Right Pre-Defensive Area	Count	2	2	4
	Expected Count	2.1	1.9	4.0
	% within COMP	.5%	.6%	.5%
Left Pre-Offensive Area	Count	72	47	119
	Expected Count	62.9	56.1	119.0
	% within COMP	17.8%	13.0%	15.5%
Middle Pre-Offensive Area	Count	79	91	170
	Expected Count	89.9	80.1	170.0
	% within COMP	19.5%	25.2%	22.2%
Right Pre-Offensive Area	Count	1	9	10
	Expected Count	5.3	4.7	10.0
	% within COMP	.2%	2.5%	1.3%
Left Offensive Area	Count	71	45	116
	Expected Count	61.3	54.7	116.0
	% within COMP	17.5%	12.5%	15.1%
Middle Offensive Area	Count	66	79	145
	Expected Count	76.7	68.3	145.0
	% within COMP	16.3%	21.9%	18.9%
Right Offensive Area	Count	10	24	34
	Expected Count	18.0	16.0	34.0
	% within COMP	2.5%	6.6%	4.4%
Total	Count	405	361	766
	Expected Count	405.0	361.0	766.0
	% within COMP	100.0%	100.0%	100.0%

The playing pattern exhibited by the left midfield player suggests that the team uses this player as an attacking force through the middle of the pitch in domestic games whereas in Europe he is used more down the wing. It seems that the playing strategy in domestic soccer is to attack more centrally rather than using the left hand side of the pitch, but in European soccer they seem to try and attack more down the left hand side of the pitch. However, further analysis of the left backs role within the team seems to suggest that he is used more as an attacking force in domestic soccer than European (16.4% compared to 13.9% and 8.3% to 5%, Table 4.12), therefore compensating for the left midfielders more central role and providing the team with width.

The centre back's contributions in his designated areas of the pitch (central defensive) did not appear to differ very much between European and domestic competitions (Table 4.14) but his contributions on the right side of the pitch did. Specifically he operated more in the right defensive area at the expense of the right pre-defensive area in domestic matches with the opposite occurring in the European matches. In the middle defensive area the percentage of his contributions were slightly higher in domestic competition than in European, which does not coincide with previous findings, however, the difference is less than 3% suggesting that his role does not differ significantly between the two competitions in this area of the pitch. In the middle pre-defensive area there is no difference between the two competitions. These patterns for the centre back imply that he is asked to perform the same job irrespective of the competition. It would appear that it is the midfielders who are required to provide more defensive cover to the centre backs and asked to perform differently depending upon which competition the team are playing in. The chi-squared analysis proved significant ($p < 0.05$) for the centre backs contributions in the different areas of the pitch in Europe and domestic soccer, but should be treated with some caution because of the relatively low numbers in some cells and the fact that the main areas in which he operated, middle defensive and pre-defensive, did not differ.

Table 4.14: Frequency of contributions by the centre back in the different areas of the pitch in European and domestic matches

Area		Competition		
		European Cup	Domestic	Total
Left Defensive Area	Count	2	1	3
	Expected Count	1.4	1.6	3.0
	% within COMP	.4%	.2%	.3%
Middle Defensive Area	Count	132	158	290
	Expected Count	138.6	151.4	290.0
	% within COMP	29.7%	32.5%	31.1%
Right Defensive Area	Count	8	34	42
	Expected Count	20.1	21.9	42.0
	% within COMP	1.8%	7.0%	4.5%
Left Pre-Defensive Area	Count	4	3	7
	Expected Count	3.3	3.7	7.0
	% within COMP	.9%	.6%	.8%
Middle Pre-Defensive Area	Count	190	202	392
	Expected Count	187.4	204.6	392.0
	% within COMP	42.7%	41.6%	42.1%
Right Pre-Defensive Area	Count	49	41	90
	Expected Count	43.0	47.0	90.0
	% within COMP	11.0%	8.4%	9.7%
Left Pre-Offensive Area	Count	3	1	4
	Expected Count	1.9	2.1	4.0
	% within COMP	.7%	.2%	.4%
Middle Pre-Offensive Area	Count	31	25	56
	Expected Count	26.8	29.2	56.0
	% within COMP	7.0%	5.1%	6.0%
Right Pre-Offensive Area	Count	16	10	26
	Expected Count	12.4	13.6	26.0
	% within COMP	3.6%	2.1%	2.8%
Middle Offensive Area	Count	10	11	21
	Expected Count	10.0	11.0	21.0
	% within COMP	2.2%	2.3%	2.3%
Total	Count	445	486	931
	Expected Count	445.0	486.0	931.0
	% within COMP	100.0%	100.0%	100.0%

Finally a chi-squared analysis was performed on the centre forward as all other playing positions have now been analysed (Table 4.15). No differences were observed in the general playing patterns of the team in the areas of the pitch that a centre forward operates, the offensive areas, so it was expected that the individual player should show no difference between the two competitions. The chi-squared analysis confirmed this as the centre forward did not differ significantly in his contributions

when comparing European and domestic matches (p = 0.33). He operated predominately in the central offensive areas in both domestic (73.0%) and European matches (67.9%).

Table 4.15: Frequency of contributions by the centre forward in the different areas of the pitch in European and domestic matches

Area		Competition		
		European Cup	Domestic	Total
Middle Defensive Area	Count	8	2	10
	Expected Count	4.3	5.7	10.0
	% within COMP	2.3%	.4%	1.3%
Right Defensive Area	Count	3	2	5
	Expected Count	2.2	2.8	5.0
	% within COMP	.9%	.4%	.6%
Left Pre-Defensive Area	Count	3	3	6
	Expected Count	2.6	3.4	6.0
	% within COMP	.9%	.7%	.8%
Middle Pre-Defensive Area	Count	23	28	51
	Expected Count	22.1	28.9	51.0
	% within COMP	6.7%	6.2%	6.4%
Right Pre-Defensive Area	Count	9	7	16
	Expected Count	6.9	9.1	16.0
	% within COMP	2.6%	1.6%	2.0%
Left Pre-Offensive Area	Count	12	9	21
	Expected Count	9.1	11.9	21.0
	% within COMP	3.5%	2.0%	2.6%
Middle Pre-Offensive Area	Count	113	155	268
	Expected Count	116.2	151.8	268.0
	% within COMP	32.8%	34.4%	33.7%
Right Pre-Offensive Area	Count	20	35	55
	Expected Count	23.8	31.2	55.0
	% within COMP	5.8%	7.8%	6.9%
Left Offensive Area	Count	5	6	11
	Expected Count	4.8	6.2	11.0
	% within COMP	1.4%	1.3%	1.4%
Middle Offensive Area	Count	121	174	295
	Expected Count	127.9	167.1	295.0
	% within COMP	35.1%	38.6%	37.1%
Right Offensive Area	Count	28	30	58
	Expected Count	25.1	32.9	58.0
	% within COMP	8.1%	6.7%	7.3%
Total	Count	345	451	796
	Expected Count	345.0	451.0	796.0
	% within COMP	100.0%	100.0%	100.0%

4.5 Passing analysis

While the areas of the pitch utilised by the players have indicated general patterns of play, the type of action performed is potentially more important in terms of tactical manipulations of the team and individuals than the actual outcome or success of their behaviour as it is the players intentions rather than their ability to carry the skill out that reflects a teams strategy. The success of the actions simply reflects the level of success that the tactics have achieved. In this respect the type of pass, focusing on whether it was difficult or easy rather than the specific outcome, was examined. The players' passes were analysed for differences in the ratio of difficult and easy passes made from different areas of the field as a function of European and domestic competition. The findings indicated that the central midfield players did not differ significantly between Europe and domestic soccer in the ratio of easy compared to difficult passes (P = 0.34). Most passes were easy (69.4%), with the majority of the difficult passes played from the middle pre-defensive (7.0%) and pre-offensive areas (11.4%). The biggest difference occurred in the pre-defensive area where there appeared to be a slight tendency to play more attacking difficult passes in domestic matches (23.5%) compared to Europe (20.1%, Table 4.16).

Table 4.16: The ratio of difficult to easy passes played by midfield players in the pre-defensive area

	Europe			Domestic		
	Easy	Difficult	N	Easy	Difficult	N
Player 1	72.0%	28.0%	164	64.9%	35.1%	211
Player 2	77.9%	22.1%	113	77.1%	22.9%	166
Player 3	91.2%	8.8%	181	87.6%	12.4%	202
Player 4	71.7%	28.3%	60	77.8%	22.2%	99
Total	79.9%	20.1%	518	76.5%	23.5%	678

When the wide players were analysed significant differences were observed in relation to the left midfielder who showed a difference in passing ($P < 0.05$) in the pre-defensive areas. Here, 37.9% of his passes in domestic matches were observed to be difficult compared to 18% in Europe (Figure 4.5). This difference is a significant one, however, the number of passes that the player made in these areas is relatively small as he did not participate in every analysed game due to injury. This casts a doubt over whether an accurate reflection of the players passing patterns has been established.

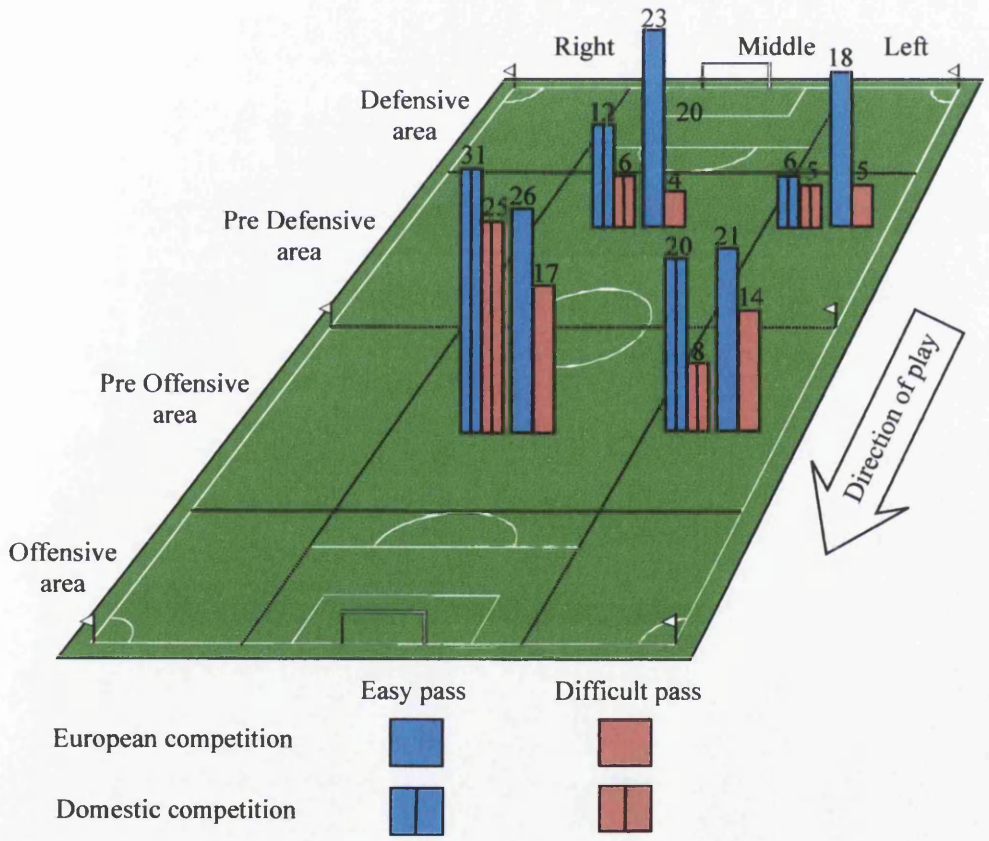

Figure 4.5: The frequency of difficult to easy passes played by the left midfielder in the left and middle pre-defensive and pre-offensive areas

The right midfielder did not significantly differ in passing selection between Europe and domestic competitions but the incidence of difficult passing suggests that the player performs in a very attacking manner (Figure 4.6). Indeed, in the critical areas of play in Europe it was found that the player actually made more difficult passes (54.8%) than easy ones. This would appear to contradict the individuals pattern of passing in domestic games (43.9% were difficult).

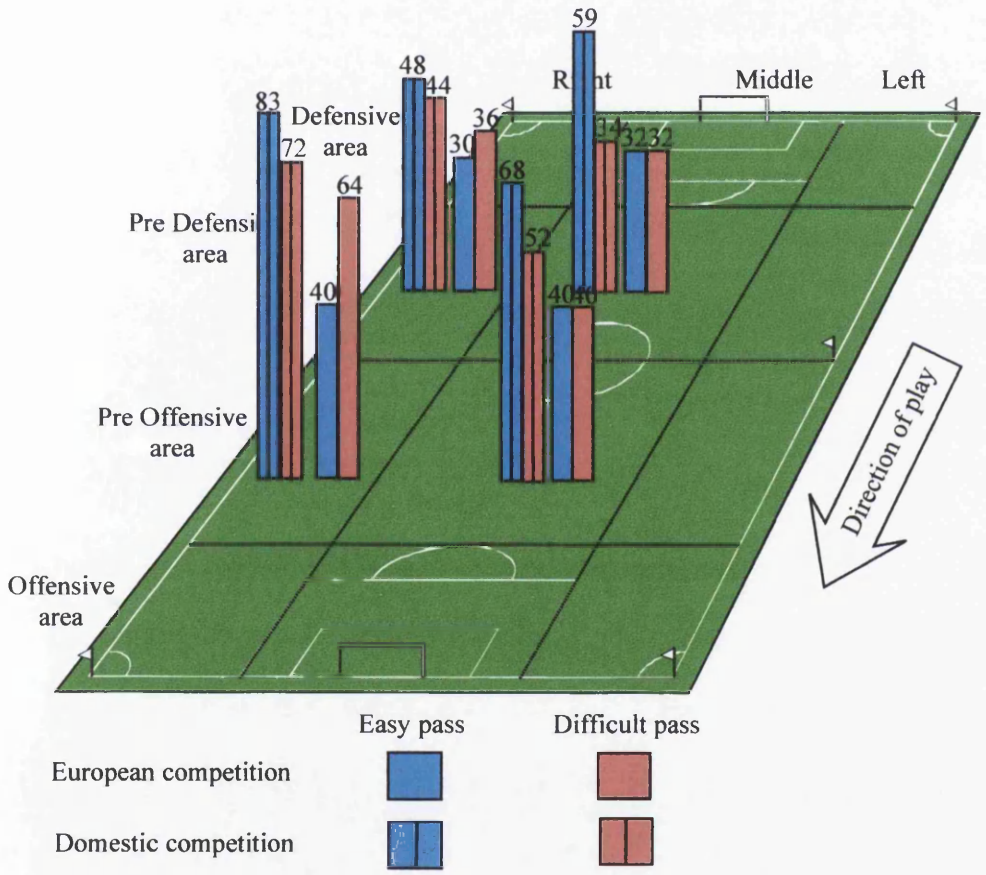

Figure 4.6: The frequency of difficult to easy passes played by the right midfielder in the right and middle pre-defensive and pre-offensive areas

4.6 Analysis of shots

Having looked at the playing patterns of some of the players individually an analysis of all the shots taken at goal was performed in an attempt to establish some team patterns in creating these shooting opportunities. The final analysis of the study looked at the starting area and number of passes in each possession that resulted in a shot at goal. Initially the goals scored in all the twenty-one games were analysed in relation to the starting area of the pitch in which each period of possession began (Figure 4.7). In total only thirty-four goals were scored so further analysis was conducted on goals and shots combined to provide more data.

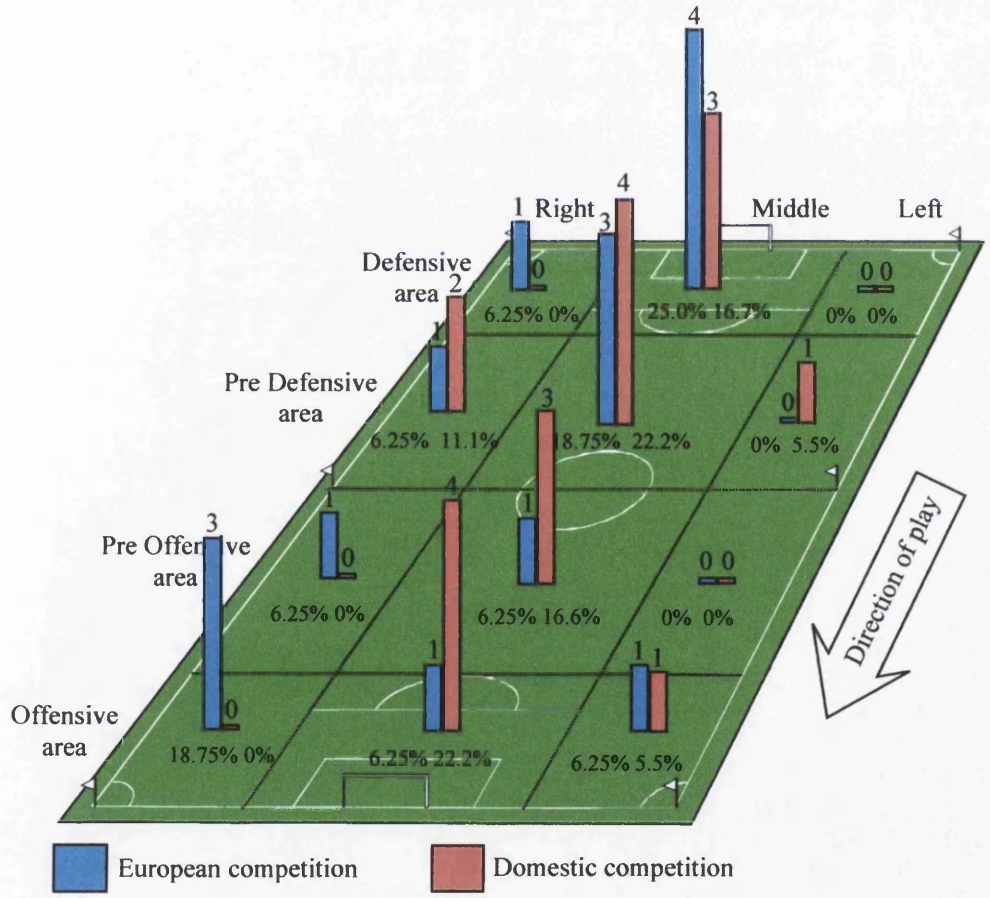

Figure 4.7: Frequency and percentage of starting areas of periods of possession leading to a goal

Figure 4.7 shows that over half, 56%, of the moves leading to a goal started in the defensive half of the field. A large portion of these moves, 21%, started in the penalty area, suggesting periods of possession spanning the length of the pitch culminating in a goal. However without data regarding the number of passes in each possession it is impossible to ascertain whether the possession involved a long kick by the goalkeeper or a passing sequence involving a number of players. Appendix 7 breaks down each possession culminating in a goal according to the area of the pitch the possession started and the number of passes in the possession. This shows that possessions starting in the middle defensive area consisted of between 4 and 10 passes before the goal was scored. However given the very small sample size it is unwise to make further assertions on the possessions culminating in goals scored. Rather it is better to include possessions which culminated in an unsuccessful attempt at goal (Appendices 8 and 9). In these instances although a goal was not necessarily scored from the move a goal scoring opportunity was created. It is argued that the more chances that a team creates the greater the likelihood of them scoring and thus these goal scoring opportunities should be analysed in order to assess the team's attacking tactics. Whilst differences can be observed in Appendices 8 and 9 between the European and domestic matches the cell frequencies are again very low making assertions hazardous. Whilst it is tempting to look at differences e.g. the frequency of goals scored through a move with one pass (domestic soccer 5 goals compared to only one in European games) the possibility of this being a random event is too high to make valid assertions. On this basis the three sets of data, goals scored, shots on target but saved and shots off target were combined (Figs 4.8 and 4.9).

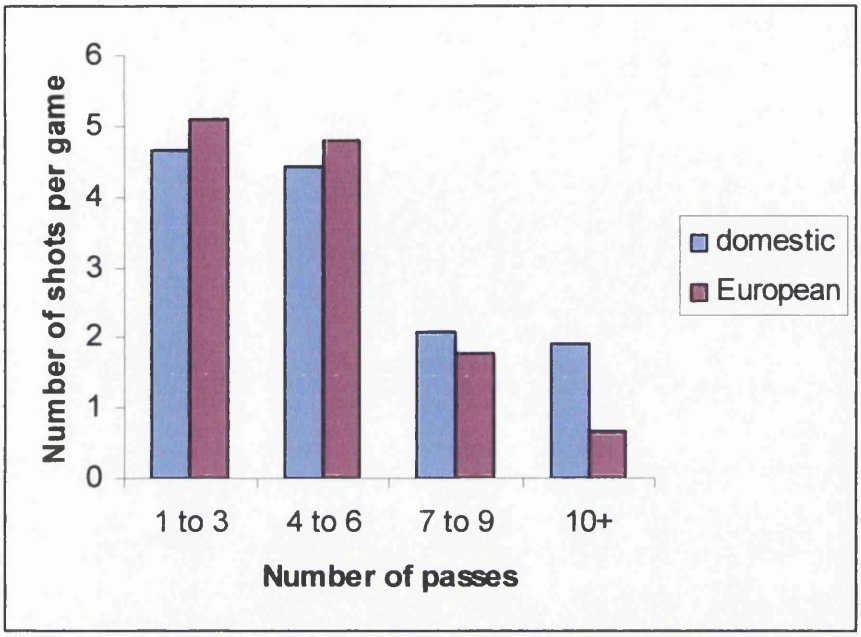

Figure 4.8: Frequency of attempts at goal in relation to the number of passes in a possession per European and domestic game

The frequency of goal attempts in relation to the number of passes for each possession was very similar between domestic and European matches except when the possession consisted of 10 or more passes. In the domestic games 1.92 (n=23) goal scoring opportunities per match were created compared to 0.67 (n=6) in European matches for moves consisting of ten or more passes. Figure 4.8 shows that slightly more shots were taken per game for periods of possession consisting of six or less passes in European soccer compared to domestic whereas periods of possession of a longer duration produced more shots domestically than in Europe. Further analysis was then performed on the shot data taking into account the area of the pitch from which each move began. The slight differences observed in Figure 4.8 did not appear to manifest itself from any particular area of the pitch (Fig. 4.9).

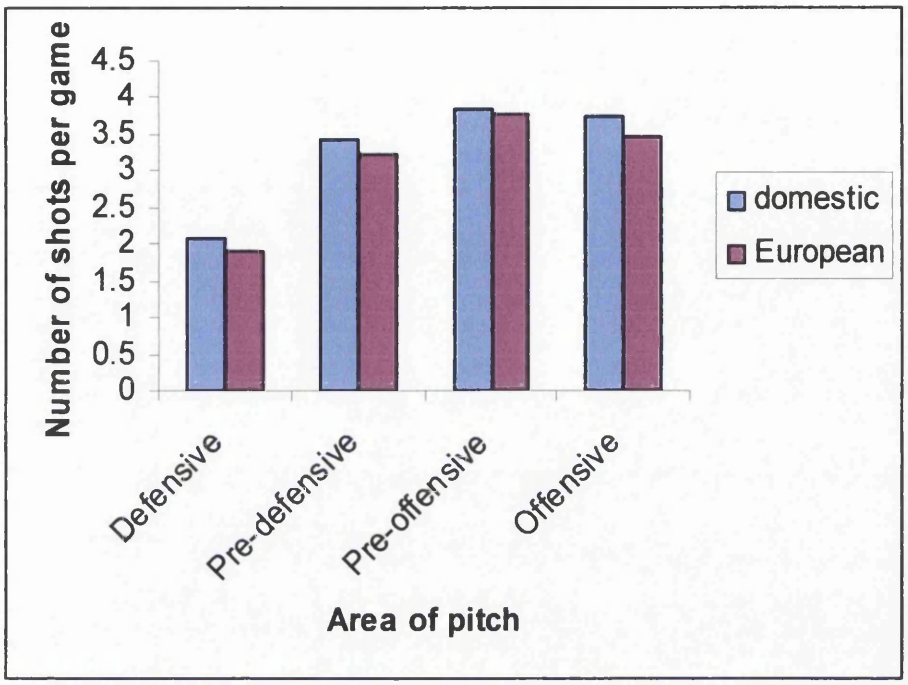

Figure 4.9: Frequency of attempts at goal in relation to the area of the pitch where possession began per European and domestic game

The above suggests that it is difficult with the amount of data (average shots per game was 13.08 in domestic and 12.33 in European matches) to make concrete assertions regarding passing strategies leading to goals or goal scoring opportunities. Domestically the goal to shot ratio (1:8.72) was slightly inferior to the European matches (1:6.94) where the team was slightly more successful in terms of average points gained (1.77 compared to 1.42). This suggests that the assertion that creating more goal scoring opportunities may be over simplifying the relationship between goals scored and shots attempted. The quality of the shots attempted and consequently the shot to goal ratio appears to determine the success of the team's performance better than the number of shots *per se*.

4.7 Summary of findings

The study has highlighted some general trends when comparing the team's tactics in domestic and European competition. In European matches there were more incidents of player activity in the pre-defensive areas of the pitch compared to the pre-offensive areas seen domestically. When attacking the ball tended to be played down the right hand side of the pitch in domestic games more so than in Europe. This seemed to culminate in better penetration into the critical middle offensive area of the pitch in the domestic matches.

Individual player analysis showed that only one of the four central midfield players significantly differed in his contributions in the different areas of the pitch between Europe and domestic matches. He, like the other three players, had higher levels of activity in the pre-defensive area at the expense of the pre-offensive area in Europe. Both right and left full backs were more active defensively in European soccer than domestic with the left back being used more as an attacking force in domestic soccer. The right midfielder did not differ in his offensive actions but the left midfielder was used more centrally in domestic soccer. The passing analysis showed that the right midfield player attempted a higher proportion of difficult passes than easy ones and this ratio was much higher than anyone else in the team. Another trend was the central midfielders' tendency to play more difficult passes from the pre-defensive areas of the pitch in domestic soccer than in European games. Finally, it was found that although the team created less scoring opportunities in Europe they converted a higher proportion of these chances into goals.

5 Discussion

5.1 Introduction

The purpose of the current thesis was to address a limitation in the existing literature by adopting a longitudinal idiographic approach to analyse tactical strategies employed by a professional soccer team across a competitive season. Specifically, differences in team strategy were examined between performances in domestic and European competition. Individual player comparisons were also made to further establish individual influences on tactical strategies. The majority of previous studies examining notational analysis in soccer have tended to focus predominantly on goals scored and how they occurred. Therefore, in order to provide a more accurate picture of tactical play this study was concerned with the development of goal scoring opportunities rather than the outcome variable of goals scored *per se*. Instead of simply looking at goals scored all goal scoring attempts were studied from the beginning of the move in an attempt to ascertain how these chances were created and hence generate a tactical overview of the team's strategies for both competitions. A secondary but nonetheless important aim was to test the analysis system for reliability. Both intra- and inter-reliability tests were carried out and recommendations for future tests are presented.

5.2 General findings

The initial finding of the study into where the possessions took place suggested that European matches were characterised by more play in the pre-defensive areas at the expense of the pre-offensive areas compared to domestic matches (Figure 4.4). Also in domestic matches the team attacked more down the right side of the pitch compared to European matches. To be able to interpret these findings an important question regarding possession statistics needs to be addressed. Are differences in possession a consequence of the analysed team making strategic decisions to alter

their formation and passing patterns or is it simply that the opposition's play forced the analysed team to play in different areas through their play? It seems sensible to initially suggest that the extent to which a team controls ball possession must be influenced by both teams play. For example, when a player receives the ball he may have just one feasible pass e.g. a simple square ball, or indeed a number of alternative passes e.g. longer forward passes into the opposition territory. We could thus hypothesise that the reason for a simple square pass was due to the opposition not allowing any reasonable chance of a successful forward pass, because no team-mates made good enough runs off the ball to allow such a pass, or the player may not have possessed the necessary skill to enable the more difficult passing options. It is impossible to know the answer to this question without having an insight into each player's decision-making process which is not feasible with current technology. Therefore we have to infer this process from the data captured. In order to speculate on whether it was the analysed players' intentions or the oppositions' play that determined different patterns of play between European and domestic football a number of similar analyses were conducted.

The frequency of ball entries into each area of the pitch is a calculation of the number of times the analysed team had possession of the ball in each area. This possession may have been a result of a tackle to regain possession, an interception of an opponent's pass or the reception of a pass from a team-mate. Hence, the calculated frequency contains elements of where the opposition lost possession as well as information related to where the ball was passed by the analysed team. Since this analysis did not discriminate between these aspects of play it could not be determined whether this frequency data reflected a change in the performance of the analysed team or differences in the opposition when comparing European and domestic matches. To try to address this limitation a second analysis of the time the ball spent in each area during the analysed team's possession was carried out. In this analysis possession where the player can hold on to the ball for some seconds will tend to have more influence on the descriptive statistics than quick possessions such as tackles and

first time passes. Hence, it was expected that this analysis would indicate the areas where the ball was intentionally held onto better. However it was again noted that holding on to the ball may have been as a result of the same factors previously mentioned i.e. a deliberate policy or imposed by the opposition. The findings replicated the previous one in terms of the differences between European and domestic matches i.e. between pre-defensive and pre-offensive and attacking down the right side of the pitch. This suggests that whilst the reasons for the differences between European and domestic football cannot be ascertained in terms of strategy the differences seem to reflect both where the ball is won (largely attributed to the opposition but indicative of a propensity to make tackles in areas as opposed to falling back behind the ball) and the ability of the team to hold onto the ball (possibly strategic but also the ability of the opposition to restrict passing options).

Whilst undertaking the possession analysis it was noted that other variables may have confounded the results. Typically researchers consider the venue (home or away) and the outcome (win, draw or lose) of the match as potential confounding variables. However many other variables will potentially contribute to any findings e.g. an injured player, a player playing out of position, weather conditions, pitch conditions, poor travelling arrangements or poor refereeing. Indeed the list is almost endless. This is not to suggest that confounding variables should be ignored, rather the notational analyst should be aware of these factors when interpreting the analyses and attempt to control for them as best as possible. To account for specific confounding variables the data set on which the analyses are conducted needs to be sufficiently large to avoid making assertions on very low frequencies. In this respect the possession data was looked at treating match venue and outcome as independent variables. Both analyses suggested that these did indeed influence the possession data to the extent that the differences seen between European and domestic football appeared to only exist in matches played at home (n=5 in Europe compared to 6 in domestic) and where the result was a draw (n=4 in Europe compared to 2 in domestic). It was felt that in order to make sense of these findings in a legitimate manner more matches needed to have

been analysed as outliers (distributions were consistently positively skewed with outliers as high values) would have affected the findings. Since this was not possible with the time restraints of the study it was decided to treat the overall findings with caution and recommend that future analyses carefully consider the number of matches required to enable testing of confounding variables. It should also be noted, however, that whilst previous researchers have used variables such as match result as a confounding variable some debate should take place as to the appropriateness of the variables chosen. For example, when using the result of a match as an independent variable, consider the case of a match where the home team won 2-1. This match could have been dominated by the home side that deserved to win and the opposition merely scored a late consolation goal. Alternatively, it could have been a very tightly contested match where both sides deserved a draw but a poor decision by one of the referee's assistants in the last minute allowed a clearly offside goal to count. In most if not all previous analyses reported in the literature both of these matches would be coded exactly the same. Is this acceptable? In one sense it is, i.e. the team in both cases won the game and that is all that counts in terms of the result. However in the case of the analyses for this thesis it is argued that this is not an appropriate way of categorizing matches. Since the focus of attention is on possession a more fine grained analysis of the match is required as opposed to merely whether the team won or not. When watching football matches is it evident that different periods in the match are characterised by different amounts of possession for each team. For example, one team may have 70% of possession for the first 10 minutes followed by 20 minutes where possession is shared equally. Both of these time periods can be contained within a match that was won or lost but could be very different in terms of how possession was gained and used. It is suggested that future analyses of possession should consider this aspect of play. Whilst this thesis did not address this issue it is thought that since the possession data was remarkably similar when comparing European and domestic matches the incidences of each type of passage of play (in terms of overall supremacy by a team) would have been normally distributed and hence equal within the relatively large data sets of European and domestic matches.

Given the above reservations and suggestions a tentative explanation for the differences in possession between European and domestic football was considered. Either the European sides exerted more spatial pressure thereby forcing the play into the defensive areas of the analysed team (a possible sign of a difference in opposition strength) or a strategy of attempting to bring the opposition out of their own half, thereby creating more space in the oppositions half, was adopted in Europe. Previously, Partridge *et al.* (1993) suggested that 'pressurising' tactics were the best form of defence. This may indeed have been the tactic employed more by the European sides than the domestic opposition, hence reflecting the difference in possession seen. Also Yamanaka *et al.* (1993) observed that British teams had significantly fewer passes in the midfield areas of the pitch, intent instead on moving the ball forward as quickly as possible, compared to the European teams. This was not specifically tested for however since this study was of just one Premiership team and comparisons were not available. The previous studies are slightly dated and the recent influx of large numbers of international players has changed the complexion of domestic Premiership football. Hence whilst this team may, or may not, adopt a different style of play compared to other domestic teams it is unwise to agree or disagree with the previous findings on the basis of this research.

The analysis also revealed that attacking play tended to take place more down the right hand side of the pitch in domestic games (right offensive and pre-offensive frequencies above their expected levels) compared to European games (Figures 4.2 and 4.4). Jinshan *et al.* (1993) and Partridge *et al.* (1993) highlighted the importance of crossing the ball for creating goal scoring opportunities and penetration into the opposition's penalty area. This may explain the better penetration into the critical middle offensive area observed in the domestic games. The European teams may have specifically tried to negate the strength of the team's play down the right side of the pitch as a consequence of analysing previous performances. Alternatively a strategic change to be less reliant on the right for attack may have been favoured by the studied team. However, the results indicated that there was no corresponding increase in the

frequency of ball entries on the left hand side in Europe, suggesting that it was more likely the superior defensive strategies employed by European sides that resulted in these differences.

Yamanka *et al.* (1993) highlighted differences in strategy between soccer sides around the world suggesting that British sides tended to use the 'long ball' mode of attack. The current study suggests that, at least for the team analysed, this is no longer the case. Indeed the variability of attacking methods suggests there is not just one favoured route to creating goal scoring opportunities but a selection of methods employed in response to the oppositions strengths and weaknesses. Although it does appear that, when a weaker side is played, the teams preferred pattern of attack is to work the ball wide onto the right hand side of the pitch to enable a cross to be played into the opposition's danger area. However, this tactic appears to have been negated to a certain extent by the European teams who clearly pay more attention to this tactic than domestic teams and either mark the right midfield player more tightly or simply cut the supply off to the player.

Previous analyses were unable to differentiate whether possession changes were due to differences in strategy employed by the analysed team or as a consequence of the opposition's play. Consequently, individual possession was analysed to see if this could discriminate between the two determining factors for possession. The results suggested that some individuals played in very similar ways in Europe and domestically, characterised by similar ball possessions in each area of the pitch. Others players' performances, however, were found to differ significantly between European and domestic matches. For example, one of the four central midfield players was significantly more defensive in European soccer than domestically (Table 4.9). Although the other three central midfield players did not differ significantly between the two competitions they operated more in the middle pre-defensive area in Europe than they did in domestic soccer (confirming previous team findings). However, whether the four central midfield players had been asked to play deeper in European

soccer (strategy change) is still not evident from this data. Further analysis of the four central player's individual roles suggested that two of them had more offensive roles than the other two. This would suggest that whilst the general trend was to defend deeper in European soccer the four players had individual responsibilities and as such demonstrates a strategic plan for the midfield players. To some extent differences were apparent between European and domestic matches with some players needed to defend more in Europe, whereas, others maintained their relative contributions across competitions. These individual differences for players in similar roles were repeated at other positions. For example, on the right hand side of the pitch the right back was significantly more defensive in European soccer (supporting previous findings). The right midfield player, however, showed no difference in his activity between domestic and Europe competition. On the left hand side of the pitch the left back was more active in both defensive areas in European football reflecting the team's defensive possession in Europe. However, offensively, the player's responsibilities also appeared to differ as he was used much more in attack in domestic soccer than in Europe. This coincided with the left midfield player's more central role in domestic soccer compared to Europe suggesting the left back was used more as a wing back to provide the width which was lost through the midfielders move inside. This is the most persuasive evidence so far of an overall team strategy that allowed individuals to adopt different roles dependant on the circumstances of the specific game. This may have been determined by the skill levels of the individual players, the standard of the opposition or the tactics the opposition traditionally employ.

The final analysis related to possession differences was the passing analysis. It was hypothesised that the ratio of easy to difficult passes would be different according to the type of player (more skilful passers would make more difficult passes) and the opposition (specific weakness may be identified by difficult passes into certain areas). The passing analysis for the four central midfield players (potential players who make key passes to strikers) showed no significant difference in the ratio of easy to difficult passes when comparing European and domestic competitions. One interpretation of

this is that these individual players tend to pass in similar ways irrespective of the opposition i.e. skill level is the most prominent determinant of pass difficulty and as such is quite stable across matches. Alternatively, the type of analysis conducted was not sensitive enough to pick up differences. This could have been because too few matches were analysed, the matches were too similar, or because an overall analysis of passes tended to hide the differences within the overall data. For example, an analysis of passes forward (removing square and back passes) may have been more illuminating. A further analysis of the wide players however did find significant differences. The left midfield player played significantly more difficult passes from the pre-defensive areas in domestic soccer although this was based on low frequencies and hence treated with caution. This finding was not repeated for the right midfield player who showed no significant differences between European and domestic competitions. However, the ratio of difficult passes to easy passes for this player is noticeably higher than any other player in the team. This adds weight to the suggestion that the skill level of the player is the most important predictor of pass difficulty. One of the observations from Luhtanen *et al.'s* (2001) study of the European international championships of 1996 and 2000 suggested that the percentage of successful passes governed the success of teams in the tournament. Also Partridge *et al.* (1993) in their study observed that senior teams take more 'chances' in the final third of the pitch when passing in an attempt to create more goal scoring opportunities in relation to collegiate sides. Neither of these findings were specifically tested here although they suggest that previous researchers have considered passing to be indicative of skill level and success. Both suggestions seem plausible and warrant further investigation. The findings of the current thesis suggest that passing patterns are dependant not so much on the teams overall strategy but on the skill level of the players within the team. Consequently, a team may encourage one particularly skilful player to make a lot of difficult passes, irrespective of the opposition or area of the pitch they are in, whereas other players may have completely different objectives that are dependant on the opposition and perhaps revolve around simpler passes.

The final analysis looked at the passing moves that led to a goal or a goal opportunity. This type of analysis is popular since the number of goals scored is the only direct measure of success in football. Only 34 goals were scored in the analysed matches. The possessions leading to a goal were as likely to have started in the team's own half as they were the oppositions. Further analysis was not really viable due to the low numbers and further analyses hence included possessions that led to a shot at goal irrespective of whether the shot was on target or not. Very similar patterns existed between European and domestic matches in terms of the number of passes in each possession and where on the pitch the possession started. The only apparent difference was the incidence of goal scoring opportunities following possessions of ten or more passes. In domestic matches these possessions resulted in nearly three times as many (1.92) goal scoring opportunities per match than in Europe (0.67). This is contrary to Yamanka *et al's.* (1993) study of the British game during the 1990 World Cup where the long ball tactic prevailed. Indeed whilst the two studies are not comparable it is interesting to note that this team displayed variety in its methods for creating goal opportunities and did not persevere with just one tactical strategy. Thus, this team appears to display the tactics Yamanka *et al.* (1993) more associated with the European teams at the time i.e. to build up play by using short passes, runs, and dribbles, thereby reducing the risk of losing possession when compared to the long ball approach.

Finally, whilst the Luhtanen *et al.* (2001) study suggested that the offensive side of the game has become more important than the defensive side in predicting the success of teams, this thesis tentatively suggests that the ability of teams to make the most of the goal scoring opportunities is the crucial factor in determining success. In European matches the team created fewer chances than domestic matches but scored with a greater proportion of them. Thus they were more successful (points gained) in European matches even though they created less goal scoring opportunities than domestic matches. The simple conclusion that offensive abilities are more important is just that simplistic. This study has indicated that football as a game for analysis is

complex. The objective of rationalising a team's strategy has thrown up more questions than answers. Whilst the number of times a team puts the ball in the opposition's net is the ultimate arbiter of success how that is consistently achieved is elusive.

One of the selected aims of this thesis was to address the lack of appropriate reliability testing performed on previous notational studies (Hughes *et al.*, 2002). The two part reliability study performed in this thesis is suggested to have been a very effective methodology. The first intra-reliability test (performed on 15 minutes of data) provided very similar overall percentage success rates (> 99%) for both trials but when the data was analysed at the level of individual performance indicators (as suggested by Hughes *et al.*, 2002) the low amount of data subjected to this testing was not sufficient to provide a reliable test. When the second intra-reliability test was performed (two games worth of data) the success rate was still high (> 99%) but when broken down into the individual performance indicators it was clear that this additional analysis was necessary to provided an accurate intra-reliability test for the system. This demonstrated that the percentage of errors for each performance indicator had stabilised at fewer than 2%. The level of agreement necessary for reliability to have been achieved is dependant on how the analysis system is used and to some extent it's purpose. In the case of this study only one observer used the system for the data collection and subsequent analyses, so the issue of reliable coding was less of a problem than if multiple observers had been used. The depth of analysis was at the performance indicator level i.e. codes used for each performance indicator were compared. This is important as individual definitions may not be robust and consequently not reliable, however more gross measures of reliability that don't analyse individual performance indicators may fail to pick this up. To prevent this occurring great attention was placed on formulating the definitions (a three stage process, see methodology) which is advocated in future studies. A further inter-reliability test of the system was carried out even though no other observers were using the system. This was to check against personal bias (e.g. consistently coding

something incorrectly due to an eyesight defect) and individualistic interpretation of the coding structure (codes not sensible to other people). Again an initial test on 15 minutes did not prove reliability but the limited observer training (two hours training) was also deemed not sufficient. This test did highlight weaknesses within the training given and enabled an improved training scenario of a further four hours to be administered. The second inter-reliability test demonstrated a substantial improvement in performance (> 95% success rate) for both observers. The results of these tests suggest that the system used was reliable but highlighted the need for sufficient training to be given to new observers using the system.

A second reliability issue has been raised in terms of the amount of data collected to allow the analysis to be robust. Hughes *et al.* (2001) call this a 'normative profile' which is a performance profile that has stabilised over time. The term 'normative' in this instance does not imply normality i.e. performance indicators do not have to exist within normal distributions. Indeed, this is seldom the case, rather the descriptive statistics pertaining to the data collected should approximate the descriptive statistics pertaining to the population to which they belong. As Hughes *et al.* (2001) point out most researchers assume that this will have happened if they analyse enough performances but very few test statistically if it actually has. They then suggest different analysis techniques to compare the profile generated after say 8 matches with those after 9 and 10 matches. The paper used examples of dependent t-tests and Anova's with these numbers of matches. However, as the authors admitted, t-tests and Anova are parametric tests which although robust are susceptible to highly skewed distributions. The data collected in this study was of this nature and therefore parametric testing was ruled out. The paper further used comparisons of cumulative means with "limits of error" (a mean of the data taken from a large sample ± 10%, 5% or 1% of its magnitude). These suggested the number of games necessary to achieve sample means within say 5% of the larger sample means. However when collecting data for the first time this is not feasible. Hughes *et al.* (2001) also quite rightly suggest that the appropriate number of matches is dependant on the level of analysis.

It is also true, if their guidelines are followed, that the distribution of the population greatly influences the number of games necessary to achieve 'stability'. For example if the distribution is highly variable then more games will be needed than for a less variable distribution since the data is more likely to be similar to the population mean. The data collected in this thesis was not tested for a 'normative profile' because methodology for this procedure had not been adequately addressed during the analysis stages. This is of course a limitation of the thesis even though previously it has been argued that typically very large data sets were available for many performance indicators. When this was not the case e.g. in the shot analysis the results have been discussed in an appropriate manner. Future analyses should consider this issue carefully and appropriate statistical testing carried out.

5.3 Limitations and recommendations for future research

This thesis has provided a detailed and fine grained analysis of a Premiership team and tried to identify strategies that are indicative of that team. Several limitations were identified during the analysis stages which should be addressed in future research. At the data capture level concerns regarding the measurement system for designating behaviours in relation to specific areas of the soccer field were raised. The grid system used to divide the pitch was limited to a degree due to its relative simplicity and because pitches vary in size slightly, hence altering the grid sizes each time. To reconcile the situation as much as possible analyses of each pitch and its markings prior to coding was carried out. The separate strips cut into the pitch when mowing were used as much as possible. If a pitch was cut only in horizontal strips the borders between the defensive, pre-defensive, pre-offensive and offensive areas could be visualized well but the right, central and left areas of the pitch were more difficult. In this case peripheral advertising hoardings were used where possible. This methodological problem was largely solved if the pitch had been cut into horizontal and vertical sections, that is, mini-grids. The reliability study showed that in practice the problem was relatively small as an error rate of less than 4.1% was observed for

the two inexperienced observers. Future studies should consider the type of grid system used and how this relates to the analyses e.g. comparison of possession data needs to consider whether each grid should be the same size. Furthermore, if the analyses are to be fed back to a particular team then some discussion should take place with the coaches as to the most appropriate method for splitting up the pitch as grid preferences maybe coach specific.

A second data capture limitation concerned the computerised notation system used, the Noldus Observer Video-Pro behavioural measurement package (Noldus Information Technology, 1996). There were limitations in the number of categories the system could handle i.e. thirty-four entries in the subjects section and the behaviours and modifier sections were limited to sixteen entries. The system allowed detailed analysis but some work around solutions were required. Noldus Information Technology have, however, recently upgraded their behavioural measurement package to eliminate such limitations.

A further limitation of the current study relates to the number of matches analysed and the total number of observations made per behaviour. Although the current study attempted to increase the number of matches analysed compared to previous idiographic investigations of soccer strategy (e.g. Church and Hughes, 1986; cited in Hughes and Franks, 1997) it became obvious that 21 matches was restrictive in terms of the analyses that could be carried out. As more independent variables are considered e.g. match venue or result, then the number of matches in each cell becomes progressively smaller. That is, as Hughes *et al.* (2001) suggested, the selection of the appropriate number of matches is dependant on the level of analysis which is critical for establishing 'normative profiles'. The present thesis examined variables e.g. ball entries to an area that typically occurred hundreds of times in the complete data set down to frequencies in the twenties e.g. an individual player analysis of passes in an infrequently used area of the pitch in Europe. It is suggested that normative profiles had usually been achieved for the level of analysis but

statistical methods were not used to corroborate this. It is therefore suggested that future studies could consider calculating confidence limits for performance indicators in this regard. These can be calculated cumulatively for each match to check the 95% limits have stabilised by testing the cumulative figures against each other. Furthermore the present study could not confidently account for differences that may have been due to confounding variables because the data set was not sufficiently large to enable further splitting of the data. This was an unfortunate situation that needs to be carefully considered in future studies. Some theoretical discussion points were raised regarding confounding variables however. It was suggested that it is not sufficient to merely divide data sets according to popularly used variables e.g. game result. This is because the type of analysis may be at a more discriminating level than the confounding variable used. For example, to categorise a match as won, drawn or lost may be appropriate for some analyses but not for others. It was suggested that for possession data this is not sufficient. Future studies of possession should consider assessing the match in terms of different phases of play whereby one team has greater possession for a period of time compared to the other team. This type of analysis may better discriminate the tactics used because it is likely that a team would employ different strategies when in or out of possession. An analysis which puts both of these phases of play together may lack the discrimination necessary to highlight the strategy differences predicted.

There is also the need to consider a whole range of personal and situation variables that may affect the tactical behaviours of teams and individuals. It is not adequate to assume that players will perform similar tactical behaviours across matches without considering potential covariates specific to each match or competition. Computerised notation packages, as used in this study, allow this degree of sensitivity as variables such as time of day, match venue, officials, weather conditions, and nature of opposition can easily be added to the data. It was also noted that the list of potential covariates is almost limitless and it is therefore recommended that a careful selection

of potential covariates is considered prior to data collection and analysis to ensure that the most important are considered within subsequent analyses.

A further enhancement not available for this study would be a close consultation with the analysed team which would allow insights into strategic decision-making prior to matches. This would enable testing of the data to see if previously designated strategies were evident in the data. Post event match analysis could then be used to help tailor training sessions specifically for individual players in relation to team strategies. Assessment of this in relation to the team's performance could be measured over the season. Unfortunately work that has and is taking place in this manner tends to remain within the confines of the team who usually pay for such analyses and therefore wish to retain any findings for their personal use.

5.4 Practical implications

The practical implications that can be obtained from this thesis, and potentially used to influence future behaviour, apply to the coach of the studied team and football coaches generally, the individual players and future match analysts. One finding that should be considered by both coaches and players is the fact that taking the goal scoring chances that are created appears to be a good predictor of success. This takes Pollard and Reep's (1997) suggestion that the more times the ball enters the danger area the higher the chance of scoring one step further. This observation in itself is correct as the more times a ball is played into the danger area the more chances will be created and therefore the likelihood of scoring should increase. However, these chances need to be converted into goals to produce success. This makes the importance of taking the chances that are created extremely high. Coaches and players should be aware of this fact and, although it would appear an obvious finding, it proves how important it is to practice taking goal scoring opportunities in training so the players are used to the pressure when confronted with the situation in a match.

Many of the practical implications that the thesis has determined apply specifically to the studied team, as it is a case study, rather than soccer clubs and players in general. This is to be expected, however, as the analysis was performed in order to assess the teams tactical play which should be different to the majority of other soccer clubs as they all have different individual players and therefore capabilities. In European soccer the studied side were pushed back into their own half by the opposition which forced them to keep possession of the ball for longer periods in more defensive parts of the pitch. This is an important pattern to note as this makes the defensive players ability, when in possession of the ball, of great importance in Europe. The coach should be aware that defensive players who are comfortable with passing the ball should be used in European games and work should be performed in training on the passing ability of these players. To help the defence in Europe the presence of a central midfield player who is willing to drop back deep into the defensive area is also of importance to add extra defensive cover and another passing option when the team is in possession of the ball.

The finding that the right midfield player attempts a much higher percentage of difficult passes to easy ones in comparison to the rest of the team should also be noted. If the side is losing a game in Europe an option that could be considered by the coach is to move this player into the central midfield position. If the team is being pushed back and forced to play from within their own half, this player could be used to initiate some attacks from deep within their half. As the player is familiar with playing difficult passes it is more likely that he would create chances for other team members from such a position, although his normal ability to produce these difficult passes maybe compromised by his inability to adapt to the new requirements of that position.. These findings could all be used by the coach of the side to influence the tactics that he chooses to play in European games. It would appear that a side who could sit back deep and counter-attack quickly on the break may be the best suited to European soccer.

Many previous studies have highlighted the importance of working the ball wide into areas of the pitch from where crossing opportunities can occur in order to create goal scoring chances (Partridge and Franks., 1989a, 1989b; Jinshan *et al.*, 1993; Partridge *et al.*, 1993; Yamanaka *et al.*, 1993). This thesis has proven that the majority of action throughout a game takes place in the central areas of the pitch. The ability of a side to work the ball wide is therefore dependent on their ability to dominate the game in the central areas of the pitch. The studied team had four players who operated in the central midfield area of the pitch, two of which were more defensive in nature and two more attacking. It would appear that the coaches choice of pairing in this position would affect the teams overall tactics to the greatest extent as they should be involved with play the most throughout a game.

This thesis has proven how a match analyst can be of use in gaining statistics on players. From the 21 games that were analysed over 25,000 lines worth of data were generated. With this amount of data captured the volume of information that a coach or player could have extracted from the analysis is almost limitless. However, the amount of data that was generated from the analysis made extracting the relevant information a very time consuming and difficult process. This thesis attempted to code every event that occurred throughout a game and then extract the information post analysis. Future match analysts should decide exactly what it is they are attempting to find out before analysis and design an appropriate system to extract the relevant information during a game rather than trying to extract it post analysis. This would save the analyst time after a game, which would be of great importance if the analysis was performed for a club who required feedback soon after a match.

5.5 Conclusion

This thesis has identified differences in play for an English football team when their performances have been compared in domestic and European competitions. Specifically European play was characterised by more possession in the team's own

half (pre-defensive area) compared to the opposition's half (pre-offensive area) in domestic football. Also the right side of the field was more effectively used in attack domestically. Finally some individual players assumed slightly different roles between the two competitions which may have contributed to a slightly more successful goal to shot ratio. It is argued that some of these differences represent a change in strategy, although it is conceded that it is not possible to determine to what extent performance differences were due to tactical changes employed by the team from changes forced upon them by the opposition. The patterns of play exhibited by the team were different from the traditional British style of play identified by Yamanaka *et al.* (1993). It is suggested that a more European style, including patient passing around the middle of the pitch which typically involves intricate passing moves rather than a reliance on long balls down field, characterised the play. Whilst it can not be inferred that this typifies British soccer currently, as this is a case study, the recent influx of foreign players into the Premier League would suggest that this is plausible.

This study has provided a more fine grained analysis of team and individual performance from which strategy has been inferred. This is novel in terms of published literature although it is assumed that this type of analysis takes place within clubs although little is known about these analyses. Whilst it is suggested that overall team strategies have allowed individuals to adopt different roles in the matches analysed, it would be advisable to have insights into the coaching and training within the club to test this theory more effectively. It would be advisable to test whether certain players are used in different ways depending on the opposition's tactics during the game; as a consequence of events during the game, such as one player not being effective; or whether rigid patterns are maintained throughout the game.

The purpose of notational analysis is to provide a more detailed and objective assessment of performance during a sports match than would be achieved through a simple classification e.g. the team won. Furthermore the ability to monitor changes in

performance e.g. during winning and losing situations is imperative. It is suggested that for some performance indicators e.g. some aspects of possession, it is necessary to assess performance according to the different phases of play that occur e.g. when one team dominates another, rather than simply classifying a match as a win and analysing the data as one big set. It is thus suggested that future studies consider a range of potential confounding variables prior to analysis and consider novel methods for dealing with them.

6 References

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Appendix 1: Glossary of terms used in the thesis

Strategy	This is a plan of action devised to achieve a specific objective i.e. to maximise the strengths of a team's players and exploit the weakness of the opposition. The coach would typically have overall responsibility for devising an appropriate strategy for a match e.g. balancing players' positions, marking responsibilities and areas controlled. The players have to implement this plan (strategy) by their performance. Strategy is often used interchangeably with "style of play" or "pattern of play" although these are defined differently below
Tactics	To make a strategy work, a number of decisions and actions (tactics) have to be employed e.g. a specific defensive formation is used (zone defence or man-to-man marking) (Robertson, 2000).
Performance Indicator	These are action variables e.g. shots at goal, passes or tackles that can be directly measured and according to Hughes and Bartlett (2002) aim to define some or all aspects of successful performance or outcome. They can thus be used to assess performance at both individual and team level by e.g. monitoring them over time for changes in performance.
Variables	Variables can be actions e.g. kick, header, or descriptors used to classify events e.g. win, loss, 1st half (often referred to as independent variables).
Patterns of play (playing patterns)	A repetitive action e.g. clearance kick or series of actions e.g. a pass to the winger who crosses for the centre forward. They can be identified as having a direct effect on overall team performance and are assessed via performance indicators.
Styles of play	This is a term used to represent the summation of the patterns of play used by a team e.g. a team may employ long balls from different area of the pitch to the front players as the main attacking option. This "style of play" is often used interchangeably with strategy and tactics.

Appendix 2: Ball entries into each area of the pitch for matches played at home in European and domestic soccer

	Competition		
Area	European Cup	Domestic	Total
Left Defensive Area	110	131	241
Middle Defensive Area	397	464	861
Right Defensive Area	94	115	209
Left Pre-Defensive Area	203	224	427
Middle Pre-Defensive Area	504	633	1137
Right Pre-Defensive Area	200	237	437
Left Pre-Offensive Area	171	224	395
Middle Pre-Offensive Area	438	644	1082
Right Pre-Offensive Area	170	273	443
Left Offensive Area	98	166	264
Middle Offensive Area	324	536	860
Right Offensive Area	96	190	286
Total	2805	3837	6642

Appendix 3: Ball entries into each area of the pitch for matches played away in European and domestic soccer

	Competition		
Area	European Cup	Domestic	Total
Left Defensive Area	68	121	189
Middle Defensive Area	324	493	817
Right Defensive Area	57	118	175
Left Pre-Defensive Area	113	224	337
Middle Pre-Defensive Area	420	642	1062
Right Pre-Defensive Area	144	276	420
Left Pre-Offensive Area	131	206	337
Middle Pre-Offensive Area	432	644	1076
Right Pre-Offensive Area	149	282	431
Left Offensive Area	82	110	192
Middle Offensive Area	291	453	744
Right Offensive Area	95	151	246
Total	2306	3720	6026

Appendix 4: Ball entries into each area of the pitch for matches won in European and domestic soccer

	Competition		
Area	European Cup	Domestic	Total
Left Defensive Area	81	136	217
Middle Defensive Area	297	430	727
Right Defensive Area	64	97	161
Left Pre-Defensive Area	153	211	364
Middle Pre-Defensive Area	402	544	946
Right Pre-Defensive Area	133	200	333
Left Pre-Offensive Area	147	166	313
Middle Pre-Offensive Area	380	523	903
Right Pre-Offensive Area	125	240	365
Left Offensive Area	73	105	178
Middle Offensive Area	287	392	679
Right Offensive Area	86	147	233
Total	2228	3191	5419

Appendix 5: Ball entries into each area of the pitch for matches lost in European and domestic soccer

	Competition		
Area	European Cup	Domestic	Total
Left Defensive Area	18	80	98
Middle Defensive Area	93	403	496
Right Defensive Area	22	106	128
Left Pre-Defensive Area	36	177	213
Middle Pre-Defensive Area	104	548	652
Right Pre-Defensive Area	42	232	274
Left Pre-Offensive Area	33	183	216
Middle Pre-Offensive Area	99	530	629
Right Pre-Offensive Area	35	233	268
Left Offensive Area	16	119	135
Middle Offensive Area	63	397	460
Right Offensive Area	18	126	144
Total	579	3134	3713

Appendix 6: Ball entries into each area of the pitch for matches drawn in European and domestic soccer

	Competition		
Area	European Cup	Domestic	Total
Left Defensive Area	79	36	115
Middle Defensive Area	331	124	455
Right Defensive Area	65	30	95
Left Pre-Defensive Area	127	60	187
Middle Pre-Defensive Area	418	183	601
Right Pre-Defensive Area	169	81	250
Left Pre-Offensive Area	122	81	203
Middle Pre-Offensive Area	391	235	626
Right Pre-Offensive Area	159	82	241
Left Offensive Area	91	52	143
Middle Offensive Area	265	200	465
Right Offensive Area	87	68	155
Total	2304	1232	3536

Appendix 7: Starting area and number of passes in periods of possession leading to a goal in European and domestic soccer

	Total passes consecutive										
Area	1	2	3	4	5	6	7	8	9	10	Total
Middle Defensive				1	1	1		2		2	4 (3)
Right Defensive			1								1
Left Pre-Defensive				1							1
Middle Pre-Defensive			1		1 (1)	1		2	1		3 (4)
Right Pre-Defensive					1		1			1	1(2)
Middle Pre-Offensive	1			1	1	1					1 (3)
Right Pre-Offensive					1						1
Left Offensive		1 (1)									1 (1)
Middle Offensive	1 (4)										1 (4)
Right Offensive		2			1						3
Total	1 (5)	3 (1)	1 (1)	2 (1)	4 (3)	1 (2)	1	2 (2)	1	1 (2)	16 (18)

Appendix 8: Starting area and number of passes in periods of possession leading to a shot on goal in European and domestic soccer

	Total passes consecutive															
Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	19	Total
Middle Defensive			1		1	1 (2)	1			1						2 (5)
Right Defensive											1					1
Left Pre-Defensive				1			1 (1)								1	1 (3)
Middle Pre-Defensive		1	1	4	1	2	3		2	1				1		4 (12)
Right Pre-Defensive			1	2	1											3 (1)
Left Pre-Offensive			1					1		1						1 (2)
Middle Pre-Offensive	5	4	1	1 (2)	1 (1)	2 (1)		1				1	2			10 (12)
Right Pre-Offensive		2	1	2		1							1			5 (2)
Left Offensive			1	2	1											1 (3)
Middle Offensive	2 (2)	1	1	1												4 (3)
Right Offensive		4	1 (1)	2 (1)	1	1										3 (8)
Total	7 (2)	4 (8)	6 (4)	8 (10)	2 (5)	3 (7)	1 (5)	2	2	1 (2)	1	1	3	1	1	34 (52)

Appendix 9: Starting area and number of passes in periods of possession leading to a shot off target in European and domestic soccer

	Total passes consecutive															
Area	1	2	3	4	5	6	7	8	9	10	11	12	14	16	17	Total
Left Defensive				1		1		1			1	1				1 (4)
Middle Defensive			1 (2)	2	1 (4)	1 (1)	1	2	1 (1)		2					8 (11)
Right Defensive			1				1									1 (1)
Left Pre-Defensive				1	2 (1)	1	1	1		2						3 (6)
Middle Pre-Defensive	1		5	1 (1)	5	1	1	2 (2)	1	1		1 (1)				12 (11)
Right Pre-Defensive				1					1				1			2 (1)
Left Pre-Offensive	1		1	1 (1)	1	2	2 (1)									5 (5)
Middle Pre-Offensive	4 (7)	1 (2)	2	3		1 (1)	1 (1)	1	1						1	10 (16)
Right Pre-Offensive			1	1 (1)	2		1			1						1 (6)
Left Offensive	1	2 (2)	1 (1)	1	1 (1)							1		1		4 (8)
Middle Offensive	3 (4)	2 (1)		1		1				1						7 (6)
Right Offensive		6 (7)		2	1 (1)			1				1				7 (12)
Total	8 (13)	11 (12)	5 (10)	8 (10)	11 (9)	4 (6)	4 (6)	5 (5)	1 (4)	2 (3)	3	1 (4)	1	1	1	61 (87)